













REPUBLIC OF INDONESIA  
TAXONOMICAL REVISIONS

FLORA MALESIANA

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The Ministry of Education and Culture, in order to disseminate the results of the botanical research conducted by the Indonesian Botanical Garden, has decided to publish a series of books on the flora of the Indonesian Archipelago.

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It is hoped that this book will be of use to the students of the Indonesian Botanical Garden and to the general public.

The book is divided into two parts. The first part contains the names of the plants in the Indonesian language, and the second part contains the names in the English language.

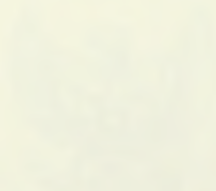
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REPUBLIK INDONESIA  
REPUBLIC OF INDONESIA  
LEMBAGA ILMU PENGETAHUAN INDONESIA (L.I.P.I.)  
INDONESIAN INSTITUTE OF SCIENCES

# FLORA MALESIANA

BEING

*AN ILLUSTRATED SYSTEMATIC ACCOUNT OF THE MALESIAN FLORA /  
INCLUDING KEYS FOR DETERMINATION / DIAGNOSTIC DESCRIPTIONS /  
REFERENCES TO THE LITERATURE / SYNONYMY / AND DISTRIBUTION /  
AND NOTES ON THE ECOLOGY OF  
ITS WILD AND COMMONLY CULTIVATED PLANTS*

PUBLISHED

UNDER THE AUSPICES OF LEMBAGA BIOLOGI NASIONAL  
BOTANIC GARDENS OF INDONESIA / BOGOR / JAVA AND  
OF THE RIJKSHERBARIUM / LEYDEN / NETHERLANDS

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AND VARIOUS PROMINENT BOTANISTS

FOR THE PROMOTION OF  
BOTANICAL SCIENCE AND THE CULTURAL ADVANCEMENT OF  
THE PEOPLES OF SOUTH-EASTERN ASIA TO  
THE SOUTHWEST PACIFIC REGION

SERIES I  
SPERMATOPHYTA



VOLUME 9

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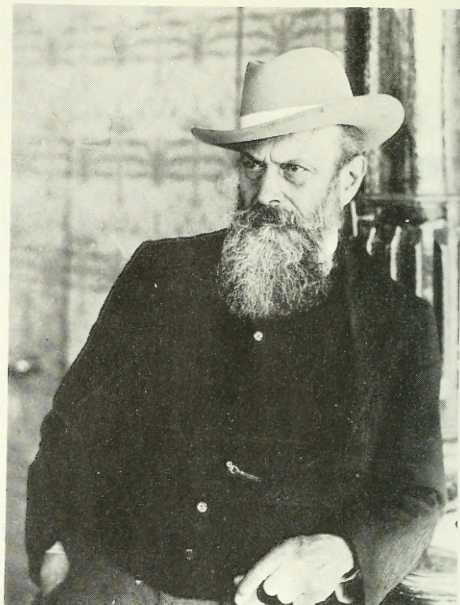
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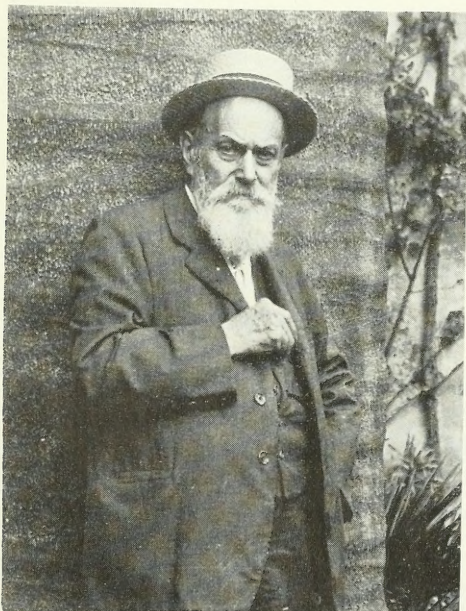
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1864



1906



1918

*Firenze, St. Museo, Via Romana 59.  
10 Novembre 1919.*

*Carissimo Gello.*

*Stasera sto riunendo i materiali per  
un possibile prossimo libro sulla  
Nuova Giuova, mi permetterei  
di sapere se fra le carte di Dorio  
si trovano per caso, delle fotografie  
delle fotografie fatte da D'Albachi.  
Fammi anche il piacere di  
sapermi dire se il Capitano Dorio  
è a Genova perché a lui ~~vorrei~~ vorrei  
domandare se ha nulla d'alta mano  
avvenute delle negative di dette  
fotografie.*

*In attesa d'una risposta che mi  
dà al tempo stesso tua notizia  
credimi con una cordiale stretta  
d. mano tuo vecchio ed affez.  
Carino*

*O'Beccari*

*Dedicated to the memory of  
ODOARDO BECCARI*



## DEDICATION

A dedication to ODOARDO BECCARI, the greatest botanist ever to study in Malesia, is long overdue. Although best known as a plant taxonomist, his versatile genius extended far beyond the basic field of this branch of Botany, his wide interest leading him to investigate the laws of evolution, the interrelations between plants and animals, the connection between vegetation and environment, plant distribution, the cultivated and useful plants of Malesia and many other problems of plant life. But, even if he devoted his studies to plants, in the depth of his mind he was primarily a naturalist, and in his long, lonely and dangerous explorations in Malesia he was attracted to all aspects of nature and human life, assembling, besides plants, an incredibly large number of collections and an invaluable wealth of drawings and observations in zoology, anthropology and ethnology. He was indeed a naturalist, and one of the greatest of his time; but never in his mind were the knowledge and beauty of Nature disjoined, and, as he was a true and complete naturalist, he was at the same time a poet and an artist.

His *Nelle foreste di Borneo, Viaggi e ricerche di un naturalista* (1902), excellently translated into English (in a somewhat abbreviated form) by Prof. E. GIGLIOLI and revised and edited by F.H.H. GUILLEMARD as *Wanderings in the great forests of Borneo* (1904), is a treasure in tropical botany; it is in fact an unrivalled introduction to tropical plant life and animals, man included. It is a most readable book touching on all sorts of topics and we advise it to be studied by all young people whose ambition it is to devote their life to tropical research.

In the last years of his life, BECCARI was rearranging his diaries, notes and observations of the expeditions to eastern Malesia with the intention of publishing a second book on his explorations, but very unfortunately death did not allow him to carry out his wish. He left only a revised copy of his diaries and field notes which formed the bulk of the book *Nuova Guinea, Selebes e Molucche*, published posthumously by his son NELLO BECCARI in 1924. It is neither well known nor duly appreciated outside Italy, since no translation has been published. Undoubtedly it lacks the glamour and freshness of the previous book, being devoid of the original and acute observations derived from his field research, which are largely profuse in his *Nelle foreste di Borneo*, but it offers a good and fascinating description of his adventurous travels with a wealth of interesting remarks, and it is an invaluable documentation of the natural features of those almost unexplored countries, particularly of the characteristics and customs of their inhabitants.

This synthesis, however, is only part of his oeuvre and before entering on his achievements, let us first look at his life and the development of his ideas and ideals.

BECCARI's early youth was ill fated. He was born in Florence, in his father's home in the Via dei Benci at the corner of Borgo dei Greci, on November 16, 1843. His mother, ANTONIETTA MINUCCI, from Radda in Chianti in Tuscany, died soon after his birth, and his father GIUSEPPE BECCARI, from an ancient family native of Rimini (Romagna), died in 1849 when ODOARDO was six years old; he was brought up by his maternal uncle MINUCCIO MINUCCI. In April 1853 he entered the Collegio 'Ferdinando' in Lucca, where his love for botany was nurtured by the Vice Rector and Prefect of Studies, the Abbé IGNAZIO MEZZETTI<sup>1</sup> and by his Professor of Botany in the Lyceum of Lucca and Director of the Botanic Garden, CESARE BICCHI. The latter, aware of the talent of his pupil and perhaps foreseeing his glorious future, in 1860 dedicated to him a new species, *Tulipa beccariana*<sup>2</sup>, the first of the numerous plants and animals to be named in his honour.

BECCARI's first collections date back to 1856, when he was a student of the College of Lucca and still only 13 years old. During his stay there he assembled a herbarium, which was still in exis-

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(1) In his honour, in 1871, BECCARI named a new genus of *Annonaceae* *Mezzettia*.

(2) *Tulipa beccariana* BICCHI, Agg. Fl. Lucch. (1860) 21, *nom. nud.*; I Giardini 8 (1861) 50, t. 2.

tence at the beginning of the present century. A search for it in Lucca as a separate herbarium was unsuccessful, but several specimens with labels headed 'Erbario Beccari' are present in the herbarium of IGNAZIO MEZZETTI, now kept in the Lyceum Machiavelli of Lucca, where BECCARI attended secondary school until July 1861. Whether these specimens are part of the separate BECCARI herbarium included in MEZZETTI's herbarium or duplicates of it, is uncertain. Other plants collected in the period in which BECCARI was a student in Lucca are kept in WEBB's herbarium in Florence.

In August 1861 he published his first paper and in the autumn of the same year, when he was 18 years old, BECCARI commenced his studies in the Faculty of Natural Science at the University of Pisa. At first, perhaps under the influence of BICCHI, he devoted his attention to the Cryptogams and already in 1862 BECCARI's name appears together with those of several eminent botanists of the time, among the collectors of the 'Erbario Crittogamico Italiano', the classical exsiccata with printed labels, founded in 1858 by GIUSEPPE DE NOTARIS of Genoa.

In the University of Pisa, BECCARI distinguished himself so much in botany, that the celebrated botanist PIETRO SAVI made him an assistant to the chair of botany in January 1863, while he was still an undergraduate. Dissatisfied with the conservatism of SAVI, however, he gave up his assistantship and moved to the University of Bologna from where he took his degree in Natural Science on July 1, 1864, by disputing his thesis on the structure of the lichen *Arnoldia cyathodes* MASS. [= *Plectopsora cyathodes* (MASS.) KÖRBER] with the famous professor in botany ANTONIO BERTOLONI.

Before his graduation, BECCARI had already planned a long journey to far away regions, when in June 1864, in the laboratory of Prof. GIOVANNI CAPELLINI, geologist at the University of Bologna, he met Marquis GIACOMO DORIA, a young, impassioned naturalist, later patron and Maecenas of science, and founder of the Museo Civico di Storia Naturale at Genoa which bears his name. The two young men, united by the same enthusiasm for scientific exploration in unknown countries, soon fraternized. Shortly after his graduation, BECCARI visited DORIA at Genoa, where they decided to undertake a long exploration together and, counselled also by the celebrated British naturalist JOHN BALL, they chose the Kingdom of Sarawak, in Borneo, as the destination of their enterprise. As part of his preparations, BECCARI spent the period from February to April 1865 in the great British centres of botany, the British Museum in London and Kew Gardens, obviously to acquaint himself roughly with the plants of Borneo. He met the HOOKERS, CHARLES DARWIN and Sir JAMES BROOKE, the Rajah of Sarawak, who assured him of the assistance of his nephew, the Tuan-muda, Sir CHARLES BROOKE, then governing the territory in his absence.

Thus prepared, young ODOARDO, at the age of 22, commenced his studies on the flora of the Malesian tropics, which was to become his main life occupation, and in which he would rise to the greatest heights as a scientific explorer, naturalist, and botanist. He sailed from Southampton on April 4, 1865, and met DORIA and his own brother, GIOVANNI BATTISTA BECCARI (who was on his way to Japan), at Alexandria. From there they travelled by train to Suez and by boat to Aden and then to Ceylon, where they spent a fortnight. There BECCARI visited the famous Botanic Gardens at Peradeniya and climbed Mt Petrotallagalla, where he made his first personal acquaintance with the tropical flora and started collecting. Via Penang island and Singapore, the voyagers arrived on June 19, 1865 at Kuching, capital of Sarawak, which they had selected as their base of operations. At the beginning they were guests of the Tuan-muda, Sir CHARLES BROOKE; later they settled in a house of their own with servants, and also bought a small boat ('sampan') for their excursions in the forests along the river. Soon BECCARI and DORIA took up their botanical and zoological collecting in the dense and primitive forests which at that time surrounded Kuching. BECCARI was anxious to know the mountains and to collect intensively; thus he undertook the construction of a



## Dedication

big hut in the forest of Gunong Mattang at an altitude of about 300 m with the intention of making it the base for the explorations and collections in the primitive forests of Borneo. However, after some months the health of DORIA deteriorated to such a point that at the beginning of March 1866 he was forced to return to Italy. Thus, BECCARI, having accompanied his friend to Singapore, remained alone to carry out the programme which he had planned with him and had hoped to realize together. At the beginning of April he moved to his house in the forest of Gunong Mattang which he called 'Vallombrosa', after the great monastery hidden in the dense mountain forest of Pratomagno, east of Florence. Together with a Chinese cook and four Malesian boys he spent nearly all the remaining months of 1866 there, except for four excursions and a period in October-November at Kuching to pack his collections. On one of these excursions to Gunong Poe he discovered a new species of *Rafflesia*, the famous parasitic plant with vegetative parts extremely reduced and a gigantic flower, the largest in the plant kingdom, apparently arising directly from the stem of the host liana. The largest flower of the new species, *Rafflesia tuan-mudae*, so named in honour of the Tuan-muda of Sarawak, Sir CHARLES BROOKE, attained about 56 cm in diameter.

In *Nelle foreste di Borneo* BECCARI gives many details of his hut at Mattang. He had cleverly designed it for drying plants and preparing zoological specimens rather than for lodging; soon it became an active and efficient laboratory, full of all sorts of products of nature. In his book he described his primitive life there as very happy and fully suited to his temperament. With only a cotton coat, trousers and a Chinese straw hat, mostly bare-footed, he carefully explored the surrounding primary forest, assembling marvellous collections of plants and animals. Back at his hut, he devoted many hours to arranging his collection, making drawings and descriptions and recording those notes and observations which later became the basis of his fascinating book *Nelle foreste di Borneo*.

At the beginning of 1867 BECCARI abandoned the hut at Mattang and spent the first two months at Kuching collecting in the surroundings, but chiefly arranging and packing his large collections. In March 1867 he again undertook his adventurous wanderings with the intention of visiting the interior of Sarawak. One of his trips from mid-March to the last days of May was devoted to the exploration of Batang-Lupar and the lakes of Kapuas with the main purpose of hunting orang-utan. He assembled there one of the best collections of these animals (skin, skeletons, heads and skulls, and even a foetus) and a wealth of observations which allowed him to express the opinion that the hominids did not originate in dense forest, like that of Borneo, and that the orang-utan, particularly well adapted to an arboreal environment, would be, not an ancestor, but a collateral of man. In his opinion, the hominids were derived from forerunners, allied to the great anthropoids of tropical Africa, with an anatomical conformation, particularly of the limbs, more suited to evolve towards a biped gait and an erect habit and they had their origin in more open vegetation, like that of some regions of tropical Africa, where we find the greatest number of large mammals with rapid locomotion. Recent research in south-western Ethiopia seems to support this hypothesis.

From August 12 to September 14, 1867, BECCARI collected in the district of Bintulu and in the country of the Kayan. From there, he was looking forward to organizing an expedition to the interior regions of Sarawak, which at that time were still nearly unexplored and hardly visited by Europeans; but his project found every possible difficulty and obstacle. Despite them, without guide or interpreter, but with only four men and a small boat, he set out on September 15 from Bintulu on his journey through the interior of Sarawak along the basins of the main rivers Bintulu, Redjang and Batang Lupar and their tributaries, across the ridges of hills and mountains which represent the watershed between them. The journey was made mostly sailing up, or down, the rivers in various native paddle boats obtained from time to time from the natives, but also on foot

to overcome some impassable rapids or to cross the ridge between two adjacent basins; often he was forced to walk with difficulty in the stream beds, or to proceed slowly with a compass through the dense forests; more than once he was in real danger, even near the end of his travels when, having lost his compass, without food, in an uninhabited region, he got lost for two days in a dense forest. On November 20, 1867, BECCARI arrived at Kuching where he concluded this long, hard and risky enterprise.

In the first two years of his stay in Borneo BECCARI's health remained excellent, but in the last months it had been deteriorating. Already in June 1867 he had suffered the first attack of malaria and later many others followed. Furthermore, in July of the same year he had observed the first symptoms of elephantiasis on his right ankle. After the expedition to the interior of Sarawak he spent two months in Kuching arranging and packing the collections he had made. He had planned another long journey crossing the inland of Borneo from Kuching to Pontianak; but in January his health worsened, and being unable to subdue the high fever which had troubled him for some days, BECCARI was forced to undertake his homeward-bound voyage. He left Kuching on January 29, 1868 and arrived in Italy on March 2, after explorations in Borneo which had lasted almost three years.

In Florence BECCARI was the guest of his old friend from the College of Lucca, EMILIO MARCUCI, who had taken up the profession of architect but had not given up his love of botany, and who greatly assisted BECCARI in that period in recovering his health. The house was located in Borgo Tegolaio 48, very close to the Museum of Physics and Natural History, where BECCARI had probably assembled his collections. The house soon became a meeting place for young lovers of natural history including LEVIER and SOMMIER. Soon after his return from Borneo G. DORIA and R. GESTRO, from the Civic Museum of Natural History of Genoa, were also his guests for several days, evidently to be informed, in detail, about the large zoological collections he had assembled in Borneo.

At that time BECCARI was very busy sorting out and working on his collections; he also made agreements with collaborating specialists to study particular groups such as seagrasses (ASCHERSON 1871), pteridophytes (CESATI 1876), mosses (HAMPE 1872), lichens (VON KREMPELHUBER 1875) and hepatics (DE NOTARIS 1876), etc. (see Appendix 4); he probably also started distributing duplicate specimens of his Bornean plants. However, together with his technical work, he carried on with the study of his collection.

In March 1869, BECCARI started, at his own expense, the publication of a new periodical, the *Nuovo Giornale Botanico Italiano*, which was intended as a replacement of the *Giornale Botanico Italiano* founded in 1844 by F. PARLATORE, but interrupted in 1852. BECCARI edited three volumes of the new periodical (1869, 1870, 1871) with the help of his friend MARCUCCI, to whom he dedicated the new genus *Marcuccia* (*Annonaceae*) as a sign of gratitude for the help received in editing these volumes, particularly during his travels in Ethiopia in 1870. His first accounts of Bornean plants appeared in early volumes of his journal and many other papers dealing with his collections written by himself and other botanists were published in subsequent volumes. However, in spring 1871, when preparing for his expedition to New Guinea, BECCARI became aware of the difficulties of editing a journal when abroad making long expeditions in distant regions and handed the management of the *Nuovo Giornale Botanico Italiano* over to T. CARUEL, who edited it until the end of 1893, when the journal became the official publication of the Italian Botanical Society, which it continues to be.

Fascinated by his primitive life in Borneo, BECCARI was not satisfied with city life. Probably he had already developed the idea of undertaking a second journey to Malesia, when he received an offer to join an Italian expedition to Ethiopia. He sailed on February 14, 1870, from Genoa and



## Dedication

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together with the zoologist Marquis ORAZIO ANTINORI and Prof. ARTURO ISSEL, geologist at the University of Genoa, visited the Bay of Assab and later, on behalf of the Italian Geographical Society, the country of Bogos. There he assembled a rich collection of plants (315 species of spermatophytes and pteridophytes and 289 species of mosses, algae, fungi and lichens) enumerated and partly described in MARTELLI's *Florula Bogosensis* (1886). He came back to Italy on October 20, 1870.

Soon after his return to Florence, BECCARI materialized his project to visit Malesia again and after careful preparations, training himself in geodetics, astronomy and meteorology, he set out on November 24, 1871 from Genoa for the island of New Guinea, accompanied by Count LUIGI MARIA D'ALBERTIS, an Italian nobleman who was passionately fond of hunting and natural history. Their first visit was to West Java where they stayed for some time in the Botanic Gardens at Bogor. The young director, Dr. RUDOLPH SCHEFFER, must have facilitated his exploring for a few days on Mt Gedeh, with its Tjibodas mountain garden, and adjacent primary forest on Mts Pangerango and Megamendong. Further stops were made at Flores and Timor in the Lesser Sunda Islands, and the islands of Banda and Ambon, where they arrived on March 7, 1872, and enjoyed the kind and helpful hospitality of Captain P.F. KRAAL and his wife, the Italian lady AMALIA MALAN. After a short journey to Buru and Ceram for information they came back to Ambon, where they organized the expedition to western New Guinea renting a small schooner, the 'Burung-Laut', of 25 tons with a crew of eight men.

On March 21, 1872, BECCARI and D'ALBERTIS sailed from Ambon to New Guinea, and having touched the islands of Geser and Goram reached Kapaor on the west coast of the mainland. Later, on April 30, they arrived at the small island of Sorong where they dismissed the Burung-Laut and rented a hut in which they established their first scientific station, collecting chiefly along the Ramoi river. They remained on Sorong island till July 15 when, having left their collections there with one of their men as keeper, they sailed in a ramshackle indigenous sailing boat with a crew of eleven Papuas to Dorei and later to Andai, where they arrived on August 7 after a long voyage, full of adventures.

BECCARI and D'ALBERTIS established their home and headquarters for the exploration of the region in a large Papuan hut built on high palafittes near the Andai river surrounded by the forest, with a splendid view of both the sea and the Arfak Mts. While D'ALBERTIS made a trip in the mountains, BECCARI collected intensively in the vicinity of Andai, but on September 28 he moved to Putat on the lower slopes of the Arfak Mts with the intention of exploring the higher regions. Unfortunately on October 9, he was informed that D'ALBERTIS had fallen seriously ill and he was compelled to return to Andai. The poor health of D'ALBERTIS necessitated that the travellers return to Ambon, but only on November 2 was BECCARI able to find an indigenous boat to reach Sorong and later Ambon. But in Sorong, unexpectedly, they found a schooner sent from Ambon in search of them. After recovering, safe and sound, the collections left there four months before, they sailed to Ambon, where they arrived on December 5, 1872. There BECCARI and D'ALBERTIS were greatly surprised to find the Italian Royal Corvette 'Vettor Pisani' on which D'ALBERTIS obtained a passage, leaving his friend alone. Thus, BECCARI concluded his first expedition to New Guinea, during which, despite all sorts of difficulties and serious health troubles, he had assembled a collection of about 700 species of plants and a rich amount of zoological, ethnographical and mineralogical specimens.

BECCARI remained in Ambon for about two months to arrange and pack the collections. There, as a guest of Captain KRAAL and his wife, he soon regained his health and prepared a trip to the Aru and Kei islands.

BECCARI departed from Ambon on February 8, 1873, having obtained a passage on a Dutch

Government steamer. Stricken with smallpox en route, BECCARI nonetheless reached the Aru islands on February 22, and with his base on Wokam, he collected plants and animals and made a topographical survey of the islands (see Appendix 1, C: Maps). On July 6, he moved to the Kei islands in a big local sailing boat, a Bughis prahu, on which BECCARI was the guest of its Chinese master. But the boat suffered shipwreck on the east coast of Grand Kei. Fortunately he could save all his collections and collecting equipment. BECCARI found the flora of these islands unexpectedly poor and after visiting Small Kei as well, he sailed on October 4 to Ambon with four men in a small indigenous sailing boat of only 4 tons, bought at Dulan. Despite the premonitions of the natives, the risky voyage of about 350 miles was successful and on October 23 he reached Ambon, where he stayed for two weeks, partly to arrange his collections, but chiefly to recover his strength, being again a guest of his friends, the KRAALS.

On November 5, 1873, BECCARI sailed by the steamer 'Koning Willem III' towards the West Moluccas (Buru and Ternate), proceeding via North Celebes towards Southwest Celebes, where he disembarked at Makassar on November 18. He stayed in the region for nearly three months until February 6, 1874. From there, as a paying passenger on an old Chinese boat of about 40 tons, similar to a prahu, he went to the larger islands south and southeast of Celebes (Kabaena and Muna) and to Kendari on the southeast coast of Celebes where he arrived on February 23. He remained in this district for six months to collect and make topographical surveys, but the collections did not increase very much because the flora was not particularly interesting and because the region was plagued with pirates on the sea, and head-hunters on land. He chiefly collected inland at Lepo-Lepo. Here he was informed that a Dutch vessel was looking for him at Kendari. It was the Escort vessel 'Sumatra' of the Royal Dutch Navy, which had been sent from Makassar in search of him, since it was rumoured that he was in danger from the pirates which infested the sea of Kendari. BECCARI had already decided to leave Kendari and accepted with pleasure the kind offer of the Captain of the vessel to take him and his men aboard to Makassar. Having packed his collections he sailed from Kendari on August 10 and arrived at Makassar after a voyage of five days.

In these last months BECCARI's funds had been running out, but early in 1874 he had already written from Makassar to his friend G. DORIA in Genoa for financial help to carry out his project of a second expedition to New Guinea. When he was back at Makassar on August 29 he received the joyfull news that his friend had convinced the authorities of Genoa to contribute 15,000 lira towards a new, second expedition to the great island.

Aware that the season was not suitable for sailing to New Guinea, BECCARI soon left Makassar by the same steamer 'Koning Willem III' on which he had travelled from Ambon to Makassar some months before. He proceeded to Bali, Surabaya, Semarang, and through the interior of Java to Bogor, to recuperate and to sort out his collections. There, he also spent some days at Tjibodas and on Mt Pangerango collecting. Unwearied, BECCARI left Jakarta on October 15, 1874, and via Surabaya, Makassar, the island of Bima and Timor in the Lesser Sunda Islands he arrived at Ternate island in the Moluccas on November 11. He remained there about 20 days and assembled rich botanical and zoological collections in the primitive forest near the hut (named by him 'Paradisino') which the Dutch Resident had built for him on the slopes of the volcano.

BECCARI intended to organize his travel to New Guinea from Ternate, but soon he realized that this was impossible, and on December 4 he left the island by the mail-steamer arriving at Ambon three days later. There he prepared for his new expedition financed by the Province and the Municipality of Genoa to West New Guinea, his old hunting grounds of 1872. He hired for his voyage the brig-schooner 'Deli' with a crew of 10, and accompanied by 8 men and a young boy for collecting plants and animals.



## Dedication

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He sailed on January 22, 1875, and arrived at Sorong Island on February 1, establishing his base in the schooner and making trips to Ramoi, Dorei Hum, Mt Morait and venturing inland from Has as far as a river, the War Samson, not then recorded on the maps. Together with plants he amassed a rich collection of birds. On March 5 he left Sorong and after a visit of some days to Waigeu Island chiefly hunting for birds, he proceeded to Dorei and soon to Warbusi and Momi on the west coast of Geelvink Bay mainly with the aim of obtaining some specimens of cassowaries. Later, in April, always in the 'Deli', he went to the islands of the Bay which he had not previously visited, spending nearly twenty days on Japen, a week on the uninhabited Mios Num, twenty days on Schouten Island and a week on a small island, Pulo Manim, near Mafor. On June 2 he arrived at Dorei where he found the Italian Corvette 'Vettor Pisani', and where he received the warmest welcome. Having arranged his collections he prepared the expedition to the Arfak Mts; on June 16 he started from Andai towards the mountains establishing his exploration base at Hatam (1500 m) in the centre of the mountain group. On June 23 he climbed one of the summits of the Arfak Mts (about 2000 m). He had planned to remain two months in the mountains, but on July 12 he was forced to cut short his exploration and to come down to the coast because of beri-beri among the crew of the schooner: two men had already died and the others were seriously ill. Thus BECCARI realized that there was no choice; he had to go back to Ternate: his second expedition to New Guinea was nearing its end; his dream of climbing and exploring the highest regions of the Arfak Mts had vanished for a second time. On July 18 he left Mansinam, near Andai, where the 'Deli' was riding at anchor, and on August 4, 1875, he arrived at Ternate, but in the meantime the beri-beri had killed most of the crew. He remained at Ternate three months arranging his collections, notes and observations.

The scientific results of the second expedition to New Guinea were very important. Even if the botanical specimens were not particularly numerous, the zoological collections were very plentiful, especially the skins of birds which surpassed 2000 in number, and included a set of birds of paradise which still remains one of the best of its kind. No less abundant were the ethnological collections consisting of every sort of object in use by natives. Also an important set of approximately 200 Papuan skulls enriched the anthropological collections. But the expedition was also very fruitful because of his untiring activity as a naturalist and explorer in making notes of everything that attracted his attention and in studying all the aspects of the regions he visited. During the expedition he had also made various topographic surveys which later allowed the geographer GUIDO CORA (see Appendix 1, C: Maps) to draw maps of some regions of New Guinea, and he had assembled a great wealth of botanical, zoological, ethnological and anthropological observations which are profusely reported in his letters published by E.H. GIGLIOLI, and in his book *Nuova Guinea, Selebes e Molucche*. Full of interest are the observations on the characteristics and origin of the Papuans, and on the life of birds, particularly those on the bower-birds of paradise, *Amblyornis inornata*, and its 'capanne e giardini', which are carefully and at the same time poetically described by him in a paper full of interesting scientific and philosophical considerations, pervaded with a deep-rooted love and admiration of Nature.

Learning that a Dutch expedition to New Guinea was being prepared, with the vessel 'Soerabaja', with the aim of performing a bathymetric survey, BECCARI received permission to accompany this. It lasted from November 11, 1875 till January 29, 1876, visiting Dorei, the Bay of Wandamen, the islands of Roon and Krudu, the Bay of Humboldt, the island Arimosa, Awek (Japen I.), Dorei, Waigeu, Misool, the Bay of MacCluer, the Bay of Gouns, the island of Geser (off Southeast Ceram), and Ambon. From there he returned on the mail steamer to Ternate. He stayed there about a month to arrange and pack his latest collections and to ship them to Italy. This third expedition to New Guinea had not yielded results as far as BECCARI's botanical and zoological in-

terests were concerned, but it had allowed him to assemble many ethnological and anthropological notes, and to improve his topographic surveys.

On March 12, 1876, BECCARI sailed from Ternate to Java, on the first stage of his homeward voyage. He arrived, unexpectedly, at Florence on June 18, 1876, after about four years of bold and glorious exploration.

On his return BECCARI was received with great honour. On July 14, 1876, the Municipality of Florence bestowed the freedom of the city on him; some scientific societies, such as the Zoological Society in London, and the Italian Anthropological Society, elected him an honorary member. Other scientific associations, such as the Italian Geographical Society and the Tuscan Society of Horticulture as well as the Faculty of Science of the Royal Institute of Advanced Studies of Florence awarded him a gold medal. But he was not affected by these honours and devoted his time to his collections and to his friends in Florence and Genoa. However, the glamour of exploration and the call of the wild were too strongly in his nature and after a year BECCARI made one further long voyage to the Malesian islands.

He and Captain COUNT ENRICO A. D'ALBERTIS, a cousin of his former companion, set out from Genoa on October 14, 1877, on a trip, properly intended more for pleasure than for science, to Australia, en route travelling through India from Bombay, Lahore, Delhi, Benares, Lucknow, to Calcutta, touching Singapore and Kuching (December 1877), meeting in Australia FERDINAND VON MUELLER, and proceeding to Tasmania and New Zealand.

On the return voyage he parted from D'ALBERTIS in Singapore and proceeded to Jakarta and then to Bogor where he spent two weeks, preparing a collecting trip in Central West Sumatra.

Sailing from Jakarta on 28 May 1878, he arrived in early June via Padang and Padang Pandjang at Mt Singalang, a primary-forest-clad, long-extinct volcano of nearly 2900 m height. Here he had a hut built, as before in Sarawak and Ternate, which he made his headquarters. The hut, named by him 'Bellavista', was placed above the limit of cultivation and on the lower fringe of the primitive forest, at an altitude of about 1700 m. He remained there from June 12 to early August, making rich collections on the flanks and on the top of the volcano. Later he set his base in a house in the village of Ajer Mantior at the base of Mt Singalang till September 20. After a short stay in Padang to arrange his collections, he undertook a journey on October 4 in the provinces and on October 22 he sailed from Padang to Bangkok where he arrived on November 10. During his travels in West Sumatra (see map of his itineraries in BECCARI 1930) he assembled large botanical and zoological collections; the largest were made on Mt Singalang, the harvest of plants running to a thousand numbers in all. Amongst them were the famous *Rafflesia arnoldii* and the then unknown, largest, erect aroid in the world, *Amorphophallus titanum*, a really colossal herbaceous plant, the tuber being up to 53 cm in diameter, the inflorescence more than 1.5 m high, the lamina of leaf covering a surface of about 15 m in circumference and the petiole attaining about 29 cm diameter at the base. From Bangkok he began his homeward journey to Italy, arriving in Florence on December 28, 1878, thus concluding the last of his fascinating explorations in Malesia.

Reviewing the results of his botanical activities in the six years exploration in the field through almost the whole of Malesia, it is evident that BECCARI's exploration in Sarawak was the most fruitful and thorough, with the huge number of over 4000 collections in two and a half years. The great virtue and value of his collections can only be properly estimated if one takes into consideration that BECCARI collected species rather than specimens, and that he seldom collected a species twice. Each species was studied, dissected and annotated on the spot and mostly carried flowers and fruit. The Sumatran collection again was rather large, about 1000 numbers in five months travel, especially when one considers that BECCARI's interests were wide; in Sumatra he also dedicated time to the study of agriculture, forest products and fruit trees, as he had done in Borneo.



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The amount of these collections clearly contrasts with less than 1000 numbers in the three years spent in the Moluccas, Celebes and New Guinea (see Appendix 4), although really there are more, as most collections from the Kei and Aru islands and Kendari in Southeast Celebes are unnumbered and unlisted. As the flora of at least New Guinea is not less rich in proportion to that of Borneo or Sumatra, the reasons for this contrast can only be explained by BECCARI's activity in the field. Firstly, we must consider that he was a thorough collector and disliked gathering occasional or incomplete specimens; he preferred always to stop some days to collect systematically in a place which he considered botanically interesting, rather than to gather here and there along his path, en route, when moving from one place to another in his long expeditions. In a word, he preferred to collect intensively rather than extensively. In Borneo and in Sumatra where he had huts for drying, labelling and drawing his specimens ('Vallombrosa' and 'Bellavista' respectively) his collections were more numerous than in New Guinea, Celebes and Moluccas when he frequently moved his collecting base, sometimes being forced to do so because threatened by native head-hunters, or by pirates. Finally, we must also bear in mind that the second expedition to New Guinea was made thanks to the financial support of the Province and Municipality of Genoa, secured on the warmest recommendation of GIACOMO DORIA, his friend and zoologist of the expedition to Borneo. BECCARI knew that he longed to enlarge the zoological collections of the Civic Museum of Natural History which he had founded in 1867, and, in his profound honesty, he felt bound to assemble large zoological collections for the Genoa Museum and to put zoology before botany. Indeed, the zoological collections were very rich in quality and in quantity, while the botanical collections were not particularly numerous. Another reason for this contrast can also be found in BECCARI's health which was worse in eastern Malesia than in Borneo and Sumatra.

In 1878 BECCARI was still only 35 years old, but had accumulated an unrivalled, immense amount of material, great scientific-botanical experience and knowledge of the Malesian flora, in fact had proved himself the greatest explorer of his time. He would prove himself also to be the greatest botanist in the elaboration of his results, surpassing BLUME in the width of the field he covered, including plant-geography, ecology and biology.

Having concluded his explorations in Malesia, BECCARI devoted the rest of his life to the study of his collections and of palms, except for an unhappy experience as Director of the Botanical Collections and Garden of the Royal Museum of Physics and Natural History of Florence in 1878–1879, and a short journey to Ethiopia soon after.

The vicissitudes of BECCARI's life as Director of the Botanical Collections and Garden cannot be understood without knowledge of some of the events in the history of the Florence Museum and the sale of BECCARI's collections. The Royal Imperial Museum of Physics and Natural History in Florence was founded in 1775 by PIETRO LEOPOLDO DI LORENA, Grand Duke of Tuscany, and was installed in a building in Via Romana, not far from the Palazzo Pitti, the palace of the Grand Duke, at the base of the great and famous Giardino di Boboli. Part of this was soon designated as the Botanical Garden of the Museum. Thanks to the great interest of the Grand Duke in Natural Science, the scientific collections were greatly increased in the years thereafter and the Museum was subdivided into various sections (Cabinets) and in 1789 an astronomical observatory was also installed there. From then on all the Museum complex was usually named 'La Specola' by the Florentines. The botanical section consisted of the so-called Botanical Collections (herbaria, carpological collections, vegetable products, wax models and fossil plants) and the Botanical Garden. After various events dominated by the historical course of Tuscany in the first half of the 19th century, FILIPPO PARLATORE was appointed in 1842 director of the Collections and Garden. He greatly contributed to the growth of the herbaria and to the organization of the department. In 1854 PHILIP BARKER WEBB died in Paris and bequeathed his invaluable herbarium and library to

the Florence Museum, together with an annual income of 6945.58 lira (derived from the sale of a palace in Paris) and known as WEBB's Legacy, for their maintenance and increase. In 1859 the Government of Tuscany established the Istituto di Studi Superiori Pratici e di Perfezionamento in Firenze, which had its centre near the Monastery of San Marco; and the Museum of Physics and Natural History with its collections and the botanical garden, although situated on the opposite side of the river Arno, became part of that Institute as the seat of the Faculty of Science. However, the Museum continued to have a director of its own, and in 1868 PARLATORE was appointed to that office. Very unfortunately, the Institute of Advanced Studies, which only became the University of Florence in 1923, had no Rector responsible for the scientific and didactic activity, but only an Administrative Board which determined the course of events in the Museum in the following years without an adequate knowledge of the problems and needs of scientific research. In 1860, after various vicissitudes, the Giardino dei Semplici, founded in 1545 and one of the most ancient in the world, became state property, and, in 1869, together with the adjoining buildings (originally the stables of the Grand Duke) was assigned to the Institute of the Advanced Studies being situated near the centre of the Institute at San Marco. In 1872 the Italian Government, the Province and the Commune of Florence signed a convention for the enlargement of the Institute of Advanced Studies, and the Board of the Institute decided to move some of the Cabinets of the Museum to the centre of the Institute. The latter also foresaw the removal of the Botanical Collections and Garden of the Museum from La Specola to the Giardino dei Semplici and pertinent buildings at San Marco, in order to have the botanical department nearer to the Institute, and to maintain only one garden, the Giardino dei Semplici, by far more famous than that of the Museum. Thus, during 1877 and 1880 the Cabinets of Chemistry, Physics, Geology and Mineralogy were shifted from the Museum to San Marco. Only in 1879 did the Commune of Florence actually hand over the Giardino dei Semplici to the Institute of Advanced Studies. The latter decided that the Botanical Collections and Garden ought soon to be moved to San Marco. However, they were conveyed there only several years later owing to the opposition of several botanists, among whom BECCARI, and other personalities, who were against the removal of the botanical collections, as they considered it, for several reasons, to be a great error.

FILIPPO PARLATORE died on September 9, 1877. He was the last Director of the Museum of Physics and Natural History in Florence as the Institute had decided that the Dean of the Faculty was to hold the directorship of the Museum. However, the office of Director of the Botanical Collections and Garden was vacant, and according to general opinion BECCARI was the best qualified and most worthy successor to the work of PARLATORE, who had so greatly enlarged the herbarium and library and raised them to the level of the greatest museums in the world. But BECCARI's appointment was strongly opposed by the Dean of the Science Faculty and the Board of the Institute of Advanced Studies, particularly because BECCARI was firmly convinced that the Director of the Botanical Collections and Garden should have no hand in teaching. On October 14, 1877, hardly more than a month after PARLATORE's death, BECCARI undertook his travels with E. D'ALBERTIS, sketched above, and at that time no resolution had been taken. Only on March 26, 1878, while BECCARI was journeying in Australia, was he, in spite of the opposition, appointed Director of the Botanical Collections and Garden of the Royal Museum of Physics and Natural History of Florence, with the duty of supervising the practical phytographic research of the students. BECCARI returned to Florence from the exploration of Sumatra on December 28, 1878, and soon took up the office of Director.

In the preceding years BECCARI had organized, worked and studied on his own in the field of botany, and his brilliant achievements were naturally a one-man show. In the field he had to make his own decisions, and learned to do so immediately. He had no rivals and had always very subor-



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dinate personnel whom he could command. That was very different from the situation in which he was now placed as a Director, with a graded staff accustomed to some privileges acquired during the long directorship of *PARLATORE*. On the other hand *BECCARI* was indefatigable and tidy in his work and he required everybody to be active and precise in carrying out his duty. He wanted to infuse new life into the operations of the botanical collections and garden, introducing methods that differed from the traditional ones. Very soon his reforms became unpopular among several of the staff, who felt that he lacked respect for the memory of his predecessor; this state of affairs acerbated the hostility towards him of the Institute of Advanced Studies. But such hostility was not something to scare him.

It is clear, of course, that *BECCARI*, with his enormous drive and ambition, proved by his unique exploration and study of the tropical floras, thinking big, botanically and otherwise, wanted to raise the Florentine centre into an institute which could compete with the leading world herbaria. For this there was excellent opportunity as the Florence botanical collections had already acquired the enormous and (still) most important herbarium of *PHILIP BARKER WEBB*, bristling with types of old collections, with funds attached for its maintenance, and further the important herbaria of *CESALPINO*, *MICHEL*, *TARGIONI*, and *PARLATORE*. To these could now be added his own numerous collections from the East, with its enormous mass of duplicates for the further enrichment of the Florence herbarium by exchange. There was, therefore, every reason and opportunity to fulfill his ambition.

When *BECCARI* took on the directorship, he was aware that the botanical collections were under threat of removal from the Museum to the buildings adjoining the Giardino dei Semplici near the centre of the Institute of Advanced Studies. At first he was rather in favour of the project since he thought that the Institute had large funds for the construction of new buildings and that they would be better and more suitable for the collections than those of the Museum. But when he discovered that the funds of the Institute were scarce, and the buildings were the old stables of the Grand Duke of Tuscany, very humid, unsuitable for both the herbarium and library, and far worse than those of the Museum, he became a most obstinate and relentless opponent to the removal of the collections. His hostility was the primary cause of a wide gulf between him and the Institute Board. On the other hand *BECCARI* began to understand that his ambition of raising the Florence Botanical Collections to the level of the other great European herbaria would be difficult to realize. But this controversy was not the reason for his resignation as Director, at least not the main one. Indeed *BECCARI*'s resignation was for a different reason.

On one of his visits to Java during his travels he had been requested by the Dutch East Indies Government to sell his collections to the Bogor (Buitenzorg) Herbarium for the cash payment of a considerable amount of money and his appointment as botanical explorer in the Garden, or a life annuity of 5000 lira. The offer was alluring, but *BECCARI* wished his collections to remain in Italy and to spend the rest of his life in Florence, attending to their study. However, his own estate was seriously compromised owing to the expenses for his long expeditions, and before his departure for the last journey to Australia, New Zealand and Sumatra (1877–1878) *BECCARI* undertook negotiations with the Florence Institute of Advanced Studies for the sale of his Malesian collections. The Institute asked *Marquis G. DORIA*, the Director of the Civic Museum of Natural History for an appraisal of *BECCARI*'s botanical collections, which were estimated at 75,065 lira. On the basis of this valuation and considering the offer of the Dutch East Indies Government, the Institute of Advanced Studies offered to buy all his botanical collections from Malesia against an annuity of 5000 lira for the rest of his life. *BECCARI* accepted this offer but on the condition that the collections were entrusted to the Museum of Physics and Natural History of Florence and that he was entitled to have them at his disposal during his lifetime; in exchange he would assume

responsibility for their study and conservation. During his journey, in May 1878, when he was in Batavia prior to his expedition to West Sumatra, BECCARI was informed that the Board of the Institute of Advanced Studies had accepted his conditions and had officially approved the purchase of his collections. Consequently he refused the offer of the Dutch East Indies Government.

When BECCARI came back to Florence and took up the directorship of the Botanical Collections and Garden of the Museum, he ought to have accepted the contract but learnt that the Board of the Institute of Advanced Studies intended to use the money from the WEBB legacy for the payment of his life annuity. BECCARI was greatly disappointed on hearing this decision, since he had thought that his life annuity would be paid by different Institute funds: he disliked the idea that the WEBB collections were to be deprived of nearly all their endowment until his own death. Furthermore, he knew that the WEBB legacy was the main source of income of the botanical department of the Museum and without it, his ambition to make the Florence herbarium one of the greatest in the world and a leading centre of tropical botany could not be accomplished. He understood too that under these conditions, the sale of his collections was incompatible with the duty of his office as Director. Indeed, he got a personal benefit from the sale, while as Director of the Collections and Garden it was his duty to avoid that these were deprived of a large amount of money necessary for their maintenance and increase during his lifetime. Thus he made every effort to persuade the Board of the Institute of Advanced Studies to use different funds to purchase his collections, but without result. He did not underestimate the hostility that the Institute had shown him since the beginning, and particularly recently, and when he was invited to sign the contract, he clearly understood that he was regarded by them as a troublemaker, and that the decision to pay the price of his collections with the WEBB legacy was merely an expedient devised by the Institute in order to compel him either to lose his prestige as Director or to resign from his office. Indeed, if BECCARI had sold his collections and kept his office he would have lost his prestige as a man and as Director, having put his personal interest before his duty. But the Board of the Institute knew that BECCARI was a man of honour and that it would achieve its aim: his resignation.

Then, as a last attempt, he tried to find some way in which, without going back on his word, he could withdraw from the compromise of the sale, but without success. Thus, on July 26, 1879, BECCARI resigned as Director of the Botanical Collections and Garden of the Florence Museum. Only later, on October 31, 1879, as a private citizen, did he sign the contract for the sale of his own collections. The fight had been lost, but his honour was saved!

Soon after the end of this unhappy and painful experience, on November 16, 1879, BECCARI left for Ethiopia to stay with his old friend and benefactor, Marquis GIACOMO DORIA, as members of an Italian expedition to the Assab Bay on the Red Sea which he had already visited in 1870. They also spent some days collecting in Aden and returned to Florence on February 26, 1880.

After his return from Ethiopia, BECCARI resumed the study of his collections, which were located in a few small rooms on the top floor of the Museum of Natural History. In those modest and secluded rooms, alone, like a hermit, without any assistant or help, but together with his rich collections, he worked until his death. There, he wrote his famous works on Malesian plants and on palm taxonomy, and made the splendid drawings and photographs which adorn his publications.

The first months there, however, were unfortunately rather hard for him. After his resignation, in November 1880 TEODORO CARUEL was appointed Director of the Botanical Collections and Garden of the Museum. He was soon instructed by the Institute of Advanced Studies to study the advisability of removing the Botanic Collections and Garden from the Museum to the Giardino



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dei Semplici and adjoining buildings, and eventually to prepare a project for such a removal which had already been decided, but not realized, before PARLATORE's death. BECCARI was aware that CARUEL between 1866 and 1871 had been Director of the Giardino dei Semplici and that he was in favour of the removal and was preparing the pertinent project. BECCARI had already expressed his resolute opposition to the removal, chiefly because the buildings near the Giardino dei Semplici were unsuitable for the collections and library as they were very humid, smaller and worse than those of the Museum, but also because library, herbaria and garden were well settled in the Museum and there was no need to remove them, and in doing so waste a large amount of money which could have been used for their maintenance and growth. Besides, he was strongly convinced that the great botanical collections and library at the Museum, as a centre of taxonomic research, had to be kept distinct from the centre of teaching and research on anatomy and physiology at the Giardino dei Semplici. Thus, in 1880 and 1881 BECCARI tried everything, with letters and articles in various Italian newspapers, to convince the Faculty of Science, the Board of the Institute of Advanced Studies, and public opinion that the removal of the botanical collections and garden would be a great and irreparable mistake. He carried out a referendum against the removal of the herbaria and library among botanists in Italy and abroad. This was spread far and wide and was discussed in many Italian and foreign publications. Numerous botanists from every part of the world, and among them the most eminent taxonomists of the time, declared themselves against the removal.

In 1881 BECCARI published a paper in which the reasons for the protest against the removal of the botanical department from the Museum and the result of the pertinent referendum were given. In the same year CARUEL published his study for carrying into effect the project of the removal of the Botanical Collections and Garden. Despite the opinions of many and outstanding botanists expressed in the referendum, the Board of the Institute of Advanced Studies decided on the removal of the Botanical Collections, Library and Garden from the Museum of Natural History, in Via Romana, to the Giardino dei Semplici and adjoining buildings near San Marco, on the opposite side of the river Arno. However, BECCARI did not give in, and he continued to publish other articles and papers against the removal until 1903. Even if his campaign did not gain its aim, it greatly contributed to further resolutions of the Institute of Advanced Studies which decided to enlarge and improve the buildings annexed to the Giardino dei Semplici and later to reserve for Botany the part of them originally intended for the Zoology department, which remained at the Museum, at La Specola, where it still is today. These deliberations greatly delayed the removal of the Botanical Collections, though the living plants of the Garden of the Museum were all moved to the Giardino dei Semplici during 1883. CARUEL continued to give his botanical lectures at the Museum until his retirement, in 1896, but the following year, his successor, O. MATTIROLO, undertook his teaching in the building near the Giardino dei Semplici. When in 1900 he moved to Turin, P. BACCARINI succeeded him as Director. At that time, the Library and the Botanical Collections were still located in the Museum.

In 1901, when the removal was close at hand, BECCARI was requested to inform the Institute of Advanced Studies in which rooms of the new botanical building at the Giardino dei Semplici he wished to have his Malesian collections deposited. He disdainfully replied that he wished his collections to remain at the Museum in Via Romana in agreement with the contract of their sale, adding that, if the Institute had decided to move them to the new buildings, he would not follow them and would give up their study. His Malesian collections remained in the same rooms at the Museum until the end of his life, but, in 1905, in spite of further protest and particularly after controversy with P. BACCARINI, the removal of the Library and the Botanical Collections (including all the herbaria) from the Museum of Natural History to the new Botanical Institute near the



ancient Giardino dei Semplici, was brought to a conclusion.

However, let us resume the course of BECCARI's life after his sad experience as Director of the Botanical Collections and Garden of the Museum in 1878–1879, and his hard fight against their removal started in 1881. These regrettable events marked a turning-point in BECCARI's career. He realized that he had lost the chance of making the Florence Herbarium one of the leading centres for research in plant taxonomy, and decided to retire to private life, devoting himself entirely to taxonomic research, chiefly to elaborate his own Malesian collections for which he had gathered a wealth of field observations and drawings.

On January 23, 1882, BECCARI married NELLA GORETTI DE FLAMINJ, from a noble family of Casentino, in the high valley of the Arno. They had four sons: NELLO, DINO, BACCIO and RENZO. The eldest, his devoted son NELLO, became a professor of Comparative Anatomy at Florence University and took great pains in editing some posthumous papers by the father, among them the book *Nuova Guinea, Selebes e Molucche* based on the original diaries of his father's explorations in eastern Malesia from 1871 to 1876. He also encouraged U. MARTELLI and R.E.G. PICHI SERMOLLI to revise and edit some works on palm taxonomy which had been left unfinished by his father.

The years immediately following BECCARI's marriage, entirely devoted to his family and to study, were peaceful and fruitful. He set up his home in a villa inherited from his father, the mediaeval Castello del Bisarno, near Ripoli in the immediate vicinity of Florence, and he lived there until his death. According to information obtained from his nephew and from letters to his friends, we know that he also had another house in the city of Florence where he and his family spent the week-days, particularly in winter. We also know that he used, as in the years before his marriage, to spend several weeks, particularly in the summer holidays and during the grape-harvest at Radda in Chianti, on the old country estate of his mother's family. He was very fond of country life and, following the tradition of the old families of the region, he was particularly interested in wine-making, in which he attained great experience. He was one of the first producers, together with Baron B. RICASOLI, of that typical wine, well-known in Italy and abroad as 'Chianti, Gallo nero'. Nevertheless, during his holidays he did not stop his research, even if he did not work so actively as in the Florence Museum, where his collections were housed.

However, after a few years his life was troubled by another sad event. In 1877 he had undertaken the publication of a great work, *Malesia*, mainly with the intention of embodying in it the results of the studies dealing with his own collections from the Malesian Archipelago; in addition, other papers or abstracts of works published elsewhere on plants of that region were also to be included. The first two volumes were printed in Genoa and BECCARI was greatly helped in editing them by his faithful friend R. GESTRO, the Director of the Civic Museum of Natural History of Genoa, particularly during his last journey to the East. However, BECCARI undoubtedly corrected the proofs of all the instalments of *Malesia* and also those of fascicle 3 of volume 1, issued when he was in West Sumatra. This is proved by a letter to GESTRO from Buitenzorg, now Bogor (dated May 2, 1878), which accompanied the corrected proofs of that fascicle. BECCARI published the first two fascicles of volume 1 at his own expense, but later *Malesia* became a publication of the Florence Institute of Advanced Studies. However, despite its great interest, the sale of this work was obviously limited, the text being written entirely in Italian. Consequently the Institute of Advanced Studies decided that it was not worth continuing its publication and suddenly, in 1887, stopped all contributions to it while fascicle 3 of volume 3 was not yet complete. Actually, in the cover of fascicle 3 we find a note which informs us that the publication of *Malesia* is ended and explains the reasons for it. However, BECCARI wished to publish at least the text pertinent to the drawings of the account on *Bombacaceae* already issued in fascicle 3, but as far as possible, also

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other papers and drawings ready for the press. Hence, he was compelled to beg in Italy and abroad for funds necessary to publish the last two fascicles of volume 3 of *Malesia*. Fortunately, the Minister of Education, PAOLO BOSELLI, and the BENTHAM Trust in England, where he was highly esteemed, allowed him the necessary financial support for bringing volume 3 of *Malesia* to a close. The last issue appeared in March 1890.

Great was BECCARI's disappointment at the unhappy conclusion of the publication of *Malesia*, not only because the resolution of the Institute of Advanced Studies represented a slight to him and to his work, but also because he had lost a safe and certain means of publication for the results of the study of his collections. He was so much upset by this event that he even thought of visiting Malesia again. Actually, in the letter to GESTRO (April 4, 1890) which accompanied the last fascicle ('ultimo definitivo') of *Malesia* he asked his friend for information on the departures from Genoa to Batavia and about the liners. Anyhow, the end of *Malesia* was another turning-point in his life: it marked the beginning of a long period of inactivity, after which he never resumed the study of his own Malesian collections.

Having concluded the studies already undertaken, he published no scientific papers from 1893 to 1902, except some articles and letters protesting against the removal of the Botanical Collections of the Florence Museum, described above, and the temporary closing of the herbaria and library in connection with this removal. In these years he was on the point of giving up his botanical activity entirely and none of his colleagues and friends, not even his devoted pupil UGO LINO MARTELLI, were able to induce him to resume his research. However, another person was to have the credit for reviving in him the enthusiasm for the country where he had spent the most fruitful period of his youth.

After his explorations in Sarawak BECCARI had kept alive his friendship with the Rajah and the Ranee of Sarawak. They liked to spend part of the year in the surroundings of Genoa. It is difficult to say whether it was by chance or with the definite intention of helping BECCARI to overcome his scientific inactivity, but in the early days of May 1897 the Ranee visited Florence and met BECCARI. A woman of great culture and sensibility, deeply fond of her kingdom of Sarawak, Lady MARGARET BROOKE succeeded in convincing BECCARI to write a book on his fascinating explorations in Borneo. He soon began his work; the Ranee kindly assisted him in the preparation of the book, particularly in providing him with the illustrations. Several of them, in fact, are a selection from many fine photographs taken by the Ranee herself in Sarawak; these were assembled in a great album, still kept in the Florence Botanical Museum, which she presented to BECCARI on June 10, 1897.

The preparation of the book, *Nelle foreste di Borneo*, led BECCARI to recover a certain interest for scientific work and it was not difficult for Prof. ORESTE MATTIROLO, the Director of the Botanical Department of the Museum, to complete the Ranee's enterprise and convince him to resume botanical research after the publication of his book. However, BECCARI had already realized that the removal of the library and the herbaria from the Museum to the Giardino dei Semplici was close at hand, and that without them the elaboration of his own Malesian collections would be rather difficult. Consequently, he did not resume their study, interrupted in 1890 after the publication of *Malesia* was stopped, and decided to devote his entire botanical activity to a single group. This decision was neither easy to take nor satisfying for him, but represented the best solution for carrying out his research without a big library and a great herbarium at his disposal at any moment of the day. The selection of the group was easy, as the Palms had intrigued him since his first visit to Malesia, and he had already done some research on them. On the other hand he knew that this group offered him a taxonomically nearly unexplored, big field. Thus, BECCARI started again on his studies with renewed enthusiasm, spending the whole day at the Museum in his



small rooms where he had concentrated everything necessary for his work, including the great camera he had designed himself specially for making the marvellous photographs which are reproduced in the plates of his truly monumental works on Palms. In the years that followed he had no difficulty in publishing his writings thanks to the great esteem he enjoyed abroad and the friendship of several Italian botanists. Actually, the publication of his chief work, *Asiatic palms*, was made possible by Sir GEORGE KING, the Director of the Botanic Garden of Calcutta, and other important papers were published by his close friend, U. MARTELLI, in the periodical *Webbia*, which the latter had founded in honour of PHILIP BARKER WEBB. Some interesting works appeared also in *L'Agricoltura Coloniale*, a journal edited by the Istituto Agricolo Coloniale, the foundation of which was promoted by BECCARI and other Italian personalities. Several other papers on palm specimens from all over the world entrusted by their collectors to him for determination, were issued in various periodicals and books.

BECCARI led this last period of his life completely secluded from Italian academic life and nearly forgotten by most Italian botanists, but he was always overwhelmed by the sympathy and esteem of foreign botanists. In this period, perhaps more than before, he enjoyed the affection of his old and devoted friends and particularly of UGO LINO MARTELLI, his only pupil, a very keen botanist himself, well known for his basic works on the great family of *Pandanaceae*, whose study he had undertaken on BECCARI's advice.

This period, entirely devoted to his family and the palm studies, was serene and creative. In the last years of his active and eventful life he assembled the materials for a book on his explorations of eastern Malesia. He had already sorted out a final copy of his diaries and he had also begun to prepare the illustrations for his book, but unexpectedly death prevented him from accomplishing this last performance.

He died peacefully in the evening of the 25th of October 1920, in Florence, at the age of 77.

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ODOARDO BECCARI was a great explorer but at the same time a very clever, many-sided, careful collector. Indeed he did incredible work in the field. In his long and lonely explorations in Malesia, BECCARI was attracted by all aspects of nature and human life and assembled an enormous wealth of botanical, zoological, ethnological and anthropological collections. Not only the number of the specimens makes his collections really invaluable, but also the fact that these are often accompanied by notes and descriptions and sometimes by splendid and detailed drawings made in the field.

The botanical collections from Malesia are kept in the Herbarium and Museum of the Florence University. They amount to more than 21,000 sheets, about 2400 flasks of material in alcohol, about 800 carpological specimens and more than 200 wood samples with the pertinent voucher specimens (see further information in VAN STEENIS'S *Thesaurus Beccarianus*). Many collection numbers are represented in BECCARI's herbarium by more than one sheet. To these specimens we must add many duplicates which were distributed to the most important herbaria, among which those of the British Museum, Kew, Paris, Geneva, Leningrad, Berlin, Leiden, Vienna, Munich, Stockholm, and Bogor.

The zoological collections consist of several thousand specimens belonging to a very high number of species, many of which were described as new. Those in the higher groups are represented by skins, but sometimes also by skeletons, skulls and even heads or other parts of the body preserved in alcohol. They are kept in the Civic Museum of Natural History of Genoa, which bears the name of its founder and Maecenas, GIACOMO DORIA, the companion of BECCARI on the expeditions to Borneo and the Red Sea. BECCARI paid attention to special groups and assembled several



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collections of particular importance such as that of the great ape, the orang-utan (48 specimens including a foetus), the set of birds of paradise, one of the best of its kind, and the collections of fishes, spiders, coleoptera, and ants. These collections have supplied a very rich harvest of study for many specialists. Indeed 205 works devoted to the study of BECCARI's zoological collections had been published by 1920 in the *Annali del Museo Civico di Storia Naturale* of Genoa alone (see GESTRO's biography of BECCARI).

BECCARI also collected rich and interesting ethnological collections of great value and beauty. They are kept in the Anthropological and Ethnological Museum of Florence and some of them are exhibited in a hall of that Museum. A set of ethnological collections was sent to the Italian Geographical Society in Rome. Some of the idols, weapons, implements, ornaments, clothing, etc. were described and illustrated in BECCARI's books *Nelle foreste di Borneo* and *Nuova Guinea, Selebes e Molucche* for the purpose of trying to establish, with the aid of the anthropological features, the origin of some of the peoples of Malesia. The value of these collections was greatly increased by the detailed information on the customs of those peoples which he described in his books and in the letters to his friends published by E.H. GIGLIOLI, G. CORA and the Italian Geographical Society.

The anthropological collections are kept in the Anthropological and Ethnological Museum of Florence. They consist of skulls and a few skeletons of natives of Malesia. The most important is undoubtedly the set of some 200 skulls assembled in Korido in the island of Schouten in north-western New Guinea. These collections were the base of the first craniological investigations on Papuans, by P. MANTEGAZZA and E. REGALIA.

BECCARI's activity in the field also extended to the geographical features of the districts he visited. During the preparation of his expeditions, he had trained himself in geodetics and topography and he had also invented a new instrument (*Nuovo orizzonte artificiale*. *Rivista Marittima* 6, 1873, 198–200, f. 1–5) for topographic surveys. During his travels he also made a topographic survey of several territories, particularly of the northwestern parts of New Guinea. These surveys later allowed G. CORA to prepare the maps he published in *Cosmos* (see Appendix 1, C: Maps). He also discovered a great river, War Samson, in northwestern New Guinea, near Sorong.

Even though BECCARI had succeeded in assembling such enormous and invaluable collections, his fame is mainly due to his scientific work condensed into more than 150 publications, some of which consist of monographs of basic importance and those on palms especially still remain standard works even today.

BECCARI's versatile mind allowed him to devote his attention to problems in different branches of natural science, but he carried out his activity chiefly in botany. In the first period, during which he made the great expeditions to Malesia, his botanical activity was essentially applied to the study of a part of his collections; the result was published mainly in the *Nuovo Giornale Botanico Italiano* which he founded in 1869. Even if some of these papers were written here and there during his explorations, his scientific output in this period was necessarily small.

With the end of his explorations in Malesia, the second period of BECCARI's activity begins. Probably he was unsatisfied when he limited himself to the descriptions of new genera and species, and in this period he spread his field of research to the monographic or semi-monographic treatment of those families or genera from Malesia which had most attracted him. In this period BECCARI also undertook, at his own expense, the publication of a collection of botanical writings, *Malesia*, in order to facilitate the printing of his papers dealing with his Malesian plants and the reproduction of his splendid drawings. For this purpose he selected the quarto size. In *Malesia* he published some of his most outstanding works. The end of its publication in 1890 marks the end of this second period of his scientific activity and also the end of the study of his own collections from Malesia.

After about a decade of complete scientific inactivity, due to the sad vicissitudes of his academic life and the end of *Malesia*, BECCARI published *Nelle foreste di Borneo* in 1902. This year coincides with the resumption of his scientific studies and marks the beginning of the third period of his botanical research in which he devoted himself entirely to the study of the family of palms, becoming the best specialist who ever existed.

In the following pages we want to go into more detail about the subjects contained in the massive oeuvre of the Maestro. Confronted with the multitude of his activities we hope to weave this into a readable account, with a distinct feeling that our ability for writing falls short of the way in which BECCARI could express himself, as testified by his '*Wanderings*', which is still a thrilling guide for exploration in the tropics.

Let us start with this work on Sarawak, the core of his main work in Malesia. He worked under favourable conditions, having ample equipment and time at his disposal, and the support of the Tuan-muda, CHARLES BROOKE. His big hut, called 'Vallombrosa' on Gunong Mattang, a hill west of Kuching, was used as a study centre. From there he made excursions and gradually familiarized himself with the very rich flora of the primary forest. He focussed attention on the big trees (*Dipterocarpaceae*, *Bombacaceae*, and others) as well as on the evasive tiny creatures of the saprophytic *Triuridaceae* and *Burmanniaceae*, the parasitic plants, the lianas and so forth, making beautiful and exemplary complete specimens in a skilled, professional way. This was, especially with unwieldy plants such as palms and pandans, gingers and aroids, quite an effort, as every field botanist must be aware. Perseverance and patience fed by infinite interest must have induced him to take particular care with these groups.

A special characteristic is that he knew his plants; hardly ever did he make two collections of the same species. As a scientific collector he was never equalled, and only approached by E.J.H. CORNER and L.J. BRASS. What a contrast with most other collectors who, even today, stick to the disgusting grab-as-grab-can way of collecting on hurried cross-country trips, causing heavy duplication and absence of vital field notes.

How BECCARI managed all this at the age of 22, with only a few months training in tropical form knowledge at Kew, can only be understood if we imagine him as an extraordinarily gifted person with an intense interest in botany; botany in the widest sense, because he was not satisfied only with the taxonomy of flowering plants, but collected for example also wood samples and cryptogams of all major phyla. His horizon widened to collecting minerals and all sorts of animals, observations on vegetation types, on edible and horticultural plants, and the way of life of his companions, the Dayak people; in short, he possessed the integrated interest of a born all-round naturalist, whose scope went far beyond the mere plant collecting and description in which he excelled. BECCARI assembled a great wealth of data on the geographical features of Borneo, on the matter of useful and horticultural plants, on fibres, rattan, bamboos, resins, camphor, getah percha yielding trees, and medicinal plants. He was aware of the primitive domestication of species of *Durio* (durian), *Eugeissona* (a palm), *Artocarpus* (breadfruit), bananas and species of *Nephelium*, which he learned from observation of Dayak life. BECCARI briefly reported on these subjects in a short summary of his journey in Sarawak to the Italian Geographical Society (1868), and later he incorporated the complete data in some appendices to his book *Nelle foreste di Borneo*. Probably, when gliding easily in canoes on the rivers or proceeding with difficulty on the mysterious peat of the swamp forests during his long journey in the interior of Sarawak, he ventured on ideas about the origin of coal in Borneo – in which he was correct. When hunting for orang-utan in Batang-Lupar or excavating in the limestone caves of Sarawak he made his first guesses about the origin of man, which he developed in *Nelle foreste di Borneo*.

He surely must have had a very busy life in his 'Vallombrosa', because he could never have con-



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ceived the '*Wanderings*' thirty years later without having copious notes of his field observations and full diaries. He must also have started in the field to compose botanical papers and preliminary revisions; when still in Sarawak he published some small papers in Italy. BECCARI was much enchanted with Sarawak, the flora, the country, and the Dayak people, and he even conceived a project that the Italian government should purchase it as a crown colony.

When BECCARI returned from Borneo to Florence he founded the *Nuovo Giornale Botanico Italiano*, in which he published freely some papers on spectacular Bornean plants; but before leaving for the expedition to New Guinea he handed over the journal to T. CARUEL, since it would be difficult both to edit it and to explore in Malesia. When, loaded with further materials, manuscripts, field notes and drawings, he returned from New Guinea to Florence, he realized the difficulty of publishing the botanical results of his explorations in the *Nuovo Giornale Botanico Italiano*. Thus he decided to undertake a collection of writings he named *Malesia*, in which he concentrated nearly all his works of that period. The first two instalments of it were published during his one year interval, spent in Florence, between the last expedition to New Guinea and the journey to Australia, New Zealand and Sumatra, and the third one appeared during the last mentioned journey. He undoubtedly must have worked very hard during that period, but he was able to manage it thanks to his efficient organization en route and the help of his friend R. GESTRO in Genoa, where *Malesia* was printed.

BECCARI published in *Malesia* several works which are important for the subject in itself, but also various original considerations about some particular subjects, such as evolutionary processes, dispersal of seeds, geographical distribution, etc. are dealt with in them. First should be mentioned the extensive work on the ant plants devoted to the study of the symbiosis between plants and ants, which occupies the entire second volume. In it, BECCARI gives us his interesting views on the evolution and the common origin of plants and animals, discussing concepts still valid and topical today. Likewise of great interest are his considerations on the origin of the insectivorous plants and the distribution of plants in the Malesian archipelago, dealing especially with the *Nepenthaceae*. Other important works are the monograph on the genus *Phoenix* and the account of the palm genus *Pritchardia* in which he resumes his considerations on the dispersal of seeds and fruits and the origin of the flora of the Pacific islands. The three volumes of *Malesia* contain also a number of monographic or semi-monographic revisions of families and genera from Malesia, e.g., *Icacinaceae*, *Menispermaceae*, *Nepenthes*, *Bombacaceae*, *Triuridaceae*, *Burmanniaceae*, etc., and also a first survey of the palms of New Guinea.

We can conclude that *Malesia* was intended to embody the botany of Malesia as a repository. It must have aroused great interest in the botanical world, containing novelties of fascinating plants with marvellous drawings made by BECCARI himself, a 'must' for every botanical institute. The use of the Italian language, even for monographic contributions from non-Italian collaborators, e.g., on *Araceae* by ENGLER, was certainly an obstacle to a wide sale, and the edition was subvented from Italian sources and the third and last volume could only appear thanks to the aid of the BENTHAM Trustees.

Whether BECCARI ever intended or hoped to achieve an ultimate incorporation of all the monographs of Malesian plant families, that is, an attempt towards a true *Flora Malesiana*, remains uncertain. The fact that he had certainly intentionally explored all areas of Malesia, except the Philippines, and that the first instalments of *Malesia* contained several monographic treatises, may support this idea. What is certain is that he fully realized that he could never dream of accomplishing all this himself. Accordingly he freely entrusted many groups to colleagues in Italy and to his many correspondents abroad as appears from the bibliography in Appendix 4.

Through the distributed duplicates BECCARI's material went to various herbaria and later came



into the hands of specialists, but much of his original collection, embodied in the original Herbarium Beccarianum, has not been examined by specialists. This original material is separately shelved in Florence, 400 bundles in 33 cupboards; to it belong a card system with field data and a cover with drawings; there is a rather large number of unicates or collections of which no duplicates were distributed. In 1951 VAN STEENIS very roughly sampled a number of families and found that BECCARI often had indicated and annotated genera *in sched.* as new, which were later based on other material, e.g., *Koordersiodendron* ENGL. (1898), *Clavistylus* J.J.S. (1910), *Neosepicaea* DIELS (1922), *Octamyrtus* DIELS (1922), *Haplolobus* H.J. LAM (1931), *Kjellbergiodendron* BURRET (1936), *Macadamia hillebrandii* STEEN. (1952), *Eriandra* v. ROYEN & STEEN. (1952), *Whiteodendron* STEEN. (1952).

It is a pity that in the past five decades too little initiative has been taken by the curators of the Florence Herbarium to attract and induce specialists to study the original BECCARI collections in Florence. We suppose that it is due to the understaffing of this great Herbarium. Especially the Herbarium Beccarianum is not a reliquiae, not a closed chapter, but truly a thesaurus, still containing unknown botanical treasures.

As this is not always realized by specialists, we urge them to borrow material of their speciality from this century-old, inexhaustible source. We sincerely hope that a revival of interest in the Herbarium Beccarianum is welcome to the future curators of the Florence Herbarium. Its possession brings with it the scientific obligation of using it, not just in honour of the Maestro, but mainly for the benefit of scientific botany and as a contribution to the fame of the Florence centre.

After publication of *Nelle foreste di Borneo* in 1902, BECCARI decided to concentrate, for the rest of his life, on the study of one large family on which he possessed more field knowledge than anyone, before or since, namely the palms. His first contribution to their knowledge dates from 1871, with a provisional account of those of Borneo. Old love never dies! In 1877 he had accounted for the palms of New Guinea, in 1885 for those cultivated in the Botanic Gardens at Bogor, but in about 1890 he spread his wings towards those beyond Malesia, the Indian empire, Indo-China, and later to Madagascar, Africa, the Pacific islands, etc. Everybody entrusted him with palm material and from this emanated a massive knowledge of Asiatic palms, embodied partly in the Records of the Botanical Survey of India, in HOOKER's Flora of India, partly later in *Webbia*, founded by his old pupil and friend U. MARTELLI, but largely in the sumptuous volumes of the *Annals of the Royal Botanic Garden, Calcutta*, which also included those of Malesia. For the large folio plates of these massive plants BECCARI designed a special large camera with suitable accessories in order to achieve excellent illustrations<sup>1</sup>. He devoted his attention mainly to the taxonomy of palms, but he also studied the cultivated species in some works which appeared in *L'Agricoltura Coloniale*, edited by that Institute once named Istituto Agricolo Coloniale, now Istituto Agronomico per l'Oltremare of which he had solicited the foundation in 1903. Of this big work a large number of unpublished manuscripts appeared in print after his death, through the untiring devotion of his pupil, friend, and colleague MARTELLI, who must be given a tribute of honour for his singularly unselfish efforts. The last of the manuscripts on palms which BECCARI left unfinished, that of the subfamily *Arecoideae*, was completed and published by PICI SERMOLLI in 1955. We should also refer here to MOORE's important and competent evaluation of BECCARI's massive contribution to the knowledge of the fascinating palm family.

(1) The large camera and other microphotographic cameras designed by BECCARI are described by LUIGI PAMPALONI, Apparecchio fotografico universale per laboratorio biologico ideato dal Dottor Beccari. Rend. Congr. Bot. Naz. Palermo (1903) 164–168, cum fig., and Gli apparecchi microfotografici del Dott. O. Beccari. Bull. Soc. Fotogr. Ital. 14 (1902) 129–145, fig. 1–7.

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Dealing with his botanical activity we cannot silently pass over his descriptive work. Also in this BECCARI excelled and showed that he had a remarkable insight into affinities. It appears that his new genera were always placed in the proper plant family and, moreover, that hardly ever were new species proposed by him reduced later, stamping him as a most accurate taxonomist. Indeed he was a taxonomist, but BECCARI showed his sharp intelligence in other branches of botany often including his considerations in taxonomical papers. Describing the details of *Gnetum* led him to considerations about the ancestry of the flowering plants from the Gymnosperms. The plant geography of the palms led him to hypothetical ideas about former landbridges and sunken continents. His gatherings in Sumatra led him to consider the affinities of its flora with those of South-east Asia and Java, concluding that the flora of volcanic ranges must be much younger than that of the more ancient and more stable Sunda lands. Other observations deal with the dissemination by earthworms; the double dispersal, anemochorous and zoochorous, of the plants of the periodic swamp forest provided with floating fruits and succulent seeds; pollination by pigeons; the various colours of flowers of the forest plants, and some others on physiology and ecology.

BECCARI also left traces of his versatile genius in various writings (papers and letters to his friends) which lie outside botany but must be mentioned briefly to understand how great he was as a naturalist. Particularly interesting are the letters to E.H. GIGLIOLI and G. CORA in which he disclosed his views on the origin of the peoples of Malesia, in particular of the Papua-Mafor which he regarded as derived from a crossing of aboriginals, perhaps descended from Negritos and Hindu peoples. Other interesting observations are those on the connections between mosquitos and malaria which he was one of the first to suppose, those on the agent of the bee pest which he suspected to be due to a protozoon later discovered in America, those on the connections between flies and cholera and numerous other observations particularly on the customs of animals.

It was in Borneo that BECCARI perceived the true value of evolution and was primarily fascinated by the importance of adaptation to environmental conditions. But only later did his views on the processes of evolution take shape in his mind. It is a fact that the prolonged stays of gifted naturalists in the tropical wilderness, when their minds are set free from daily minutiae and domesticities and solely occupied with the bewildering structural wealth of tropical plants and animals, allows their minds to open to new, big ideas and syntheses, generating philosophical thought. For this, one has only to think of VON HUMBOLDT, JUNGHUHN, WALLACE, DARWIN, and CORNER. To this, BECCARI, with his eager mind and astute power of observation, was no exception.

BECCARI was used to going back from the facts to the causes, and his views on the evolutionary processes, which arose from the observations he made in nature, were consolidating in his mind in the course of time. Thus we find his views sketched in some papers and later resumed in others, whenever he had the chance to develop them on the basis of particular new observations. He did not supply us, or perhaps he did not want to supply us, with a synthesis of his views on evolution in an *ad hoc* publication, perhaps out of humility, since he disliked giving the impression that he was able to explain the laws of evolution, or perhaps out of honesty, because he perceived that his ideas had made their way into his mind by intuition and reasoning, without adequate investigation.

BECCARI was undoubtedly an evolutionist, but he was one in a very original manner. The first foundation of his theory of '*plasmation*' was explained in his paper (1876) on the huts and gardens of *Amblyornis inornata*, the small bower-bird of paradise which builds a pretty hut with, in front, a lovely garden of soft moss on which it scatters flowers in shining colours changing them when they wither. This theory was resumed in the introduction to his work on ant plants (1884) and was later developed in his paper (1889) on the flowering of *Amorphophallus titanum*, the gigantic Aracea, and was summarized in his book, *Nelle foreste di Borneo*.

According to this theory the evolutionary processes of living beings took place, beginning with the most ancient geological times, fundamentally in two different epochs: a first epoch of *plasmation*, and a second epoch of *conservative heredity*, displaying in the course of time the two fundamental rules of variability and fixity. In the first epoch, the plasmative strength, unhindered by heredity, may have given free play to the variability and to the adaptation stimulated by environmental conditions. In that epoch, the organism may have been liable to yield to the stimulus of external factors and more subject to modelling itself to them, the modifications occurring with the greatest of ease and even quite suddenly without the offspring necessarily being like the parents. This epoch may have been a period of youth for living beings in which each individual was allowed to modify itself in conformity with its needs, or rather even according to its wishes, its vanities, its whims.

This epoch of plasmation, with a maximum of variability and a minimum of fixity, may have been followed by an epoch of conservative heredity, characterized by that strength which aims at the conservation of the acquired characters and owing to which the individuals belonging to a species transmit to their descendants the characteristics they have inherited from their ancestors. Thus the plasmative epoch may have been replaced by an epoch with a minimum of variability and a maximum of fixity. The strength of the conservative heredity becoming stronger in the course of time may consequently have weakened the faculty to vary, perhaps even to cancel it entirely, thus impressing the stamp of fixity on all living beings.

He recognized the great influence of environmental factors on the plasmation of living beings and pointed out several cases of correlation between the morphology of some apparatuses and the environmental factors. For instance, he was the first to correlate the life form of flood-resistant plants with the environment and was struck by their similarity in leaf-shape: his 'stenophyllous plants', now called 'rheophytes'. A still more important correlation amply studied by him was that of the symbiosis between plants and ants, the 'piante ospitatrici', or formicarian plants, to which he devoted a very large and detailed account (1884). However, he clearly and repeatedly recognized that plasmation could also be stimulated by an interior strength, by the wish of having some particular functions facilitated, such as defence, pollination, seed dispersal, *etc.* But BECCARI also supposed that plasmation was even influenced, particularly in the animal kingdom, by a psychic push stimulated by the beauty of the environment, as could have happened in the birds of paradise desirous of imitating with their feathers the glowing colours of the aurora and dusk of the tropics, which they greet from the highest trees of the forest with very lively dances.

Though recognizing that the extant being cannot, as a rule, undergo modifications because of the environment, BECCARI admitted however that even today some changes can take place in the species on account of a cross between individuals of different species or of the sudden appearance of hereditary modifications of various, even if unknown, origin. He admitted that these could be induced by new poisonous substances or by new enzymes arising in the substratum; thus he foresaw the existence of mutations and mutagenic substances.

BECCARI was a man of great intelligence, versatility and intuition, who united an exceptional personality and liberality with uncommon integrity and strength of mind. He was an indefatigable worker, who devoted hours and hours to his research, without a moment of rest. But he did not work out of a wish to be praised; prizes and honours did not interest him. He loved his research studies since he was zealous of the beauty and perfection of nature and only happy when he could entirely devote himself to investigating its manifold and marvellous aspects. For the same reason he liked to draw plants and animals and very few excelled him in scientific drawing.

BECCARI had an austere and inflexible character, but he was neither obstinate nor autocratic. His temperament was based on a keen sense of duty. Also in private life, although deeply fond of



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his wife, sons and friends, every action was characterized by a clear austerity, and he was greatly beloved but at the same time he always inspired a certain awe. But this austerity concealed a great goodness of heart.

He had also a great sense of justice and was a very courageous and stalwart man. These gifts united with the wish to inspire respect and love rather than fear, were greatly esteemed by native people and on his dangerous expeditions he never suffered injury from anybody. Undoubtedly he must have encountered serious danger, but he faced them with resolution, and he recounts them with indifference and without boasting.

BECCARI is described as a proud, almost misanthropic spirit and perhaps he was not an easy character and we understand why some regarded him as a troublesome person. From his youth, moulded in his long and solitary explorations in Malesia, he was set apart, destined to travel and to work alone, and he was not afraid of solitude; on the contrary, in his ripe age he found refuge in it, the better to devote himself to his studies and serve his single purpose and sole end: the science of nature.

R.E.G. PICH SERMOLLI & C.G.G.J. VAN STEENIS

## Appendix 1 — Bibliography of Odoardo Beccari

### A — Books and papers

(excluding reviews of books)

1861. Escursione botanica. — L'Araldo Cattolico, Lucca, anno XVIII, 14 agosto 1861, n. 33: 264 (not seen).
1862. Illustrazione dell'*Arnoldia cyathodes* Massal. — Comment. Soc. Crittog. Ital. 1: 128–130, t. 7.
1868. Descrizione di tre nuove specie di piante Bornensi. — Atti Soc. Ital. Sc. Nat. 11: 197–198.  
— Cenno di un viaggio a Borneo. — Boll. Soc. Geogr. Ital. 1: 193–214.
1869. Illustrazione di nuove specie di piante Bornensi. (Balanophoreae, Rafflesiaceae). — Nuovo Giorn. Bot. Ital. 1: 65–91, t. 2–5.  
— Varietà e notizie. — Ibid.: 158–160.  
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### B — Letters by Odoardo Beccari

During his travels BECCARI wrote several letters to his friends in Italy, chiefly to G. DORIA, E.H. GIGLIOLI, G. CORA, T. SALVADORI, R. GESTRO, and O. ANTINORI. They contain a wealth of very interesting observations and comments on the botanical, zoological, ethnological and other naturalistic aspects of Malesia. These letters or fragments of them were published in various Italian periodicals, usually accompanied by information and comments on BECCARI's scientific discoveries, and on the itineraries and the main events of his adventurous travels.

The bibliographic citations of the papers in which these letters are published are given below together with an indication of the name of the friend to whom the letter was addressed, and the date and place in which it was written. In order to facilitate and render more systematic the consultation of these letters, they are quoted according to the periodicals in which they were published.

#### Letters published in the *Nuova Antologia*

BECCARI's travels in Malesia, Assab and the country of Bogos between 1865 and 1876 were described by ENRICO H. GIGLIOLI in various instalments published in the *Nuova Antologia* with the general title of 'Odoardo Beccari ed i suoi viaggi'. They were also reprinted, with independent pagination, and assembled in a special book (Firenze, Le Monnier, 309 pp., 9 fig., 2 small maps, 1872–76) with the title 'I viaggi del Dott. Beccari da Firenze tracciati e commentati'. There GIGLIOLI published several letters or fragments of letters by BECCARI to his friends and also some passages from his original diaries. All of them are quoted verbatim between GIGLIOLI's descriptions and comments.

Borneo. 1865–1868. — Nuova Antologia 21 (1872) 119–160 (Passages of the original diaries).  
 Samhara e Bogor. 1870. — Ibid.: 22 (1873) 658–668.

Malesia, Molucche e Papuasias. 1871–72–73. — Ibid.: 22 (1873) 668–709. (Letters to G. Doria, from the Red Sea, December 10–11, 1871; to E.H. Giglioli, from Batavia, February 8; to G. Doria, from Makassar, February 23; Ceram, March 13; Ambon, March 21; Kapaor, April 21, with a small map; to E.H. Giglioli, from Sorong, May 3; to G. Doria, from Sorong, June 21, 1872).

Papuasia: Sorong-Mansinam-Andai (Monti Arfak). (Giugno 1872 al Gennaio 1873). — Ibid.: 23 (1873) 194–225, 2 fig. (Letters to G. Doria, from Andai, August 30; Andai, September 8–9, 1872; Ambon, January 2; Ambon, February 2–7, 1873).

Papuasia — Le isole Aru e Kei (Febbraio–Settembre 1873). — Ibid.: 24 (1873) 835–866, 1 map; 25 (1874) 163–192, 1 fig. (Letters to C. Correnti, from Ambon, January 3; to O. Antinori, from Ambon, January 3; Ambon, February 5; to G. Doria, from Dobbo (Aru Is.), February 24; Wokan (Aru Is.), March 10; Wokan, July 3–4; Tual (Kei Is.), August 27, 1873).

I. Macassar — Kandari (Celebes). II. I Papua (Dicembre 1873, Giugno 1874). — Ibid.: 27 (1874) 420–463, 5 fig. (Letters to E.H. Giglioli, from Makassar, December 4; to R. Gestro, from Ma-

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- kassar, December 1; to G. Doria, from Makassar, December 4; Makassar, December 26, 1873; Makassar, January 15; to T. Salvadori, from Makassar, January 14; to R. Gestro, from Makassar, January 15; to G. Doria, from Kandary, April 23, and May 2 and 11, 1874).
- Celebes, Giava, Ternate, Amboina (Giugno 1874–Gennaio 1875). — Ibid.: ser. 2, 2 (1876) 802–822. (Letters to G. Doria, from Kandari, June 4; Makassar, August 30; to O. Antinori, from Makassar, August 28; to T. Salvadori, from Makassar, August 30; to Baron Podestà, the Mayor of Genoa, from Makassar, end August; to G. Doria, from Ambon, December 7, 1874; to E.H. Giglioli, from Ambon, January 7; to ??, from Ambon, January 15, 1875).
- Seconda esplorazione della Nuova Guinea. La baia di Geelvink (Febbraio–Novembre 1875). — Ibid.: ser. 2, 3 (1876) 147–163. (Letters to G. Doria, from Dorei, June 5; Andai, June 15; Hatam, June 21; to T. Salvadori, from Ternate, August 4, 1875).
- Terza esplorazione della Nuova Guinea. La baia di Humboldt (Novembre 1875–Marzo 1876). — Ibid.: ser. 2, 3 (1876) 333–363, 1 fig. (Letters to G. Cora, from Ternate, March 11; to E.H. Giglioli, from Ternate, March 6, 1876).

### Letters published in the *Bollettino della Società Geografica Italiana*

- Estratti e frammenti di lettere dirette al marchese Giacomo Doria dal naturalista botanico Odoardo Beccari, durante il suo viaggio alla Nuova Guinea. — Boll. Soc. Geogr. Ital. 8 (1872) 148–151. (Letters to G. Doria, from Wahaai, March 13; Ambon, March 21; Sorong, May 3, 1872).
- Odoardo Beccari nella Nuova Guinea e nelle isole Aru. — Ibid.: 9 (1873) 145–158. (Letters to G. Doria, from Andai, August 30, 1872; to C. Correnti, from Ambon, January 3; to O. Antinori, from Ambon, January 4; to G. Doria, from Ambon, February 2, 5, 7; to O. Antinori, from Ambon, February 5; to G. Doria, from Dobbo, Aru Is., February 24; Wokan, Aru Is., March 10, 1873).
- Lettera di O. Beccari al marchese Doria. — Ibid. 10: 4–5 (1873) 66–69. (Letter from Wokan, Aru Is., July 3, 1873).
- Frammento di lettera di O. Beccari a Doria da Makassar, il 18 Novembre 1873. — Ibid.: 10: 6 (1873) 38.
- Odoardo Beccari alle isole Key. — Ibid.: 87–89. (Letter to G. Doria, from Tual (Small Kei), August 27, 1873).
- Ultime notizie di O. Beccari. — Ibid.: 11 (1874) 78–81. (Letters to R. Gestro, from Makassar, December 1; to G. Doria, from Makassar, December 4; to O. Antinori, from Makassar, December 7; to G. Doria, from Makassar, December 26, 1873).
- Corrispondenze del dott. Odoardo Beccari. — Ibid.: 276–282. (Letters to T. Salvadori, from Makassar, January 14; to R. Gestro, from Makassar, January 15; to G. Doria, from Makassar, January 15, 1874).
- Lettere di Odoardo Beccari. — Ibid.: 480–488, carta della parte sud-est di Celebes. (Letters to G. Doria, from Kandari, April 23 and June 4, 1874).
- Nota sui Papua e sulla Nuova Guinea. — Ibid.: 652–659. (Letter to O. Antinori, from Makassar, August 28, 1874).
- Lettere di Odoardo Beccari. — Ibid.: 660–667. (Letters to the Mayor of Genoa, from Makassar, without dates; to T. Salvadori, from Makassar, August 30; to G. Doria, from Kandari, June 4, 1874).
- Lettera di O. Beccari. — Ibid.: 12 (1875) 117–122. (Letter to G. Doria, from Ambon, January 4, 1875).



La Nuova Guinea Olandese. — Ibid.: ser. 2. 1 (1876) 550–557. (Letter to G. Cora, from Ternate, March 11, 1876).

Letters published in *Cosmos*

The editor of the journal *Cosmos* of Turin, GUIDO CORA, gave ample information on BECCARI's travels in Malesia. He published several letters by BECCARI to his friends in Italy, which are listed below. Furthermore, CORA gave various reports on the different stages of BECCARI's journeys. The references to the latter are given in Appendix 3 dealing with BECCARI's itineraries.

Recenti spedizioni alla Nuova Guinea. Spedizione di Beccari e D'Albertis:

1. Da Singapore ad Amboina. — *Cosmos* 1 (1873–74) 11–15. (Letters to G. Doria, from Batavia, February 8; Makassar, February 23, Wahai (N. Ceram), March 13; Amboina, March 21, 1872).
2. Da Amboina a Sorong. — Ibid.: 15–20. (Letters to G. Doria, from Kapaor, April 21; Sorong, May 3 and June 21, 1872).

Recenti spedizioni alla Nuova Guinea. Esplorazioni di Odoardo Beccari:

1. Ricerche geografiche nella Nuova Guinea. — *Cosmos* 2 (1874–75) 7–9. (Letter to G. Cora, from Makassar, December 1, 1873).
2. Note sulle Isole Kei. — Ibid.: 9–10. (Letter to G. Cora, from Makassar, December 1, 1873).
3. Da Makassar a Kandari. — Ibid.: 92–96. (Letters to G. Doria, from Kandari, May 2 and 11, 1874).
4. Escursioni intorno a Kandari. Ritorno a Makassar. — Ibid.: 203–207. (Letters to G. Doria, from Kandari, June 4; Makassar, August 30, 1874).
5. Notizie sull'ornitologia di Celebes. — Ibid.: 207–208. (Letter to T. Salvadori, from Makassar, August 30, 1874).
6. Appunti etnografici sui Papua. — Ibid.: 400–404. (Letter to O. Antinori, from Makassar, August 28, 1874).
7. Soggiorno a Ternate. Da Ternate ad Amboina. Preparativi per terzo viaggio alla Nuova Guinea. — *Cosmos* 3 (1875–76) 83–88. (Letters to G. Doria, from Amboina, January 4, 8, 9, 1875).
8. Da Amboina a Dorei, per Soron e Wakkaré. Scoperta del fiume Wa Samson. Esplorazione della baia di Geelvink, determinazione della sua vera ampiezza. — Ibid.: 88–92. (Letter to G. Doria, from Dorei, June 5, 1875).
9. Esplorazione dei Monti Arfak. Ritorno a Ternate per la via di Salvatti, Batanta, Koffiao. — Ibid.: 92–95. (Letters to G. Doria, from Andai, June 15; Hatam, June 21; to T. Salvadori, from Ternate, August 4, 1875).
10. Viaggio a bordo del trasporto olandese 'Soerabaja'. Itinerario progettato. Da Ternate a Dorei, per Salvatti. Visita ad Ansum. Lavori idrografici. — Ibid.: 220–221. (Letters to G. Doria, from Ternate, November 7; Dorei, November 26, 28, 1875).
11. Viaggio a bordo del trasporto olandese 'Soerabaja'. Da Dorei alla baia di Humboldt per la baia Vandamen, l'isola Run, il sud di Jobi, le foci dell'Ambermo. — Ibid.: 349–352. (Letter to G. Cora, from Ternate, March 11, 1876).
12. Saggio statistico sulla Nuova Guinea Olandese. Popolazione, Commercio, Climatologia, Nomenclatura. — Ibid.: 352–360. (Letter to G. Cora, from Ternate, March 11, 1876).
13. Viaggio a bordo del trasporto olandese 'Soerabaja'. La Baia di Humboldt ed i suoi abitanti.

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- La Baia del Disinganno, il Vulcano Ciclope e le isole Arimoa. — Ibid.: 364–372. (Letter to E.H. Giglioli, from Ternate, March 6, 1876).
14. Viaggio a bordo del trasporto olandese 'Soerabaja'. Dalla Baia di Humboldt a Ternate pel nord di Jobi, Dorei, Waigheu, Misol, il golfo Mac Cluer, la baia Gouns, Ghesser, Amboina. — Ibid.: 372–374. (Letter to E.H. Giglioli, from Ternate, March 6, 1876).
15. Questioni etnologiche sui Papua. — Ibid.: 375–379. (Letter to E.H. Giglioli, from Ternate, March 6, 1876).

### Letters published in various journals

- Il viaggio di O. Beccari alla Nuova Guinea. — Nuov. Giorn. Bot. Ital. 4 (1872) 208–212. (Letters to a friend of Florence, from Wahai, N. Ceram, March 13; Ambon, March 21, 1872).
- Il viaggio di O. Beccari alla Nuova Guinea. — Ibid.: 291–294. (Letters to G. Doria, from Kapaor, April 21; Sorong, June 21, 1872).
- Lettera di O. Beccari dalle isole Aru. — Ibid. 5 (1873) 330. (Letter to [G. Doria], July 3–4, 1873).
- Brano di lettera di O. Beccari da Makassar in data 1° Dicembre 1873. — Ibid. 6 (1874) 205–206.
- Una pianta maravigliosa. — Bull. R. Soc. Tosc.ortic. 3 (1878) 270–271. (Letter to R. Corsi Salvati, from Sumatra, without date. Comment by E.O. Fenzi).
- Lettera ornitologica di O. Beccari intorno agli uccelli osservati durante un recente viaggio alla Nuova Guinea. — Ann. Mus. Civ. St. Nat. Genova 7 (1875) 704–720. (Letter to T. Salvadori, from Ternate, August 4, 1875. Introduction by T. Salvadori).
- Lettera del Prof. Odoardo Beccari a Giacomo Doria. — Ibid. 13 (1878) 451–455. (From Kajù Tanam, Sumatra, September 8, 1878).

## C — Maps

In the period of preparation for his travels BECCARI carefully trained himself also in geodetics and topography. He also invented a new instrument (Nuovo orizzonte artificiale) for topographic survey.

During his explorations BECCARI devoted great attention to the topography of the places he visited and his surveys allowed him to draw some maps which greatly contributed to the delimitation of the coasts of certain areas of the Malesian Archipelago.

Some of these maps were published by BECCARI himself, others were utilized by G. CORA, together with surveys of other explorers, to elaborate some of the maps published in his periodical *Cosmos*.

BECCARI's itineraries are traced on all maps listed below.

- Carta originale del viaggio di Beccari e d'Albertis nella Nuova Guinea ovest (Aprile 1872), costruita e disegnata da Guido Cora. Scala 1:700.000. — *Cosmos* (G. Cora) 1 (1873–74) Tav. I. — Explanatory notes in Cora G. Recenti spedizioni alla Nuova Guinea. Memoria sulla Tavola I. — Ibid.: 22–24.
- Carta originale del viaggio di O. Beccari nel Sud-est di Celebes (Maggio–Agosto 1874), costruita e disegnata da Guido Cora. Scala 1:1.200.000. — Ibid. 2 (1874–75) Tav. V. — Explanatory notes in Cora G. Viaggio di O. Beccari nel Sud-est di Celebes. Note sulla Tavola V. — Ibid.: 201–202.
- Carta originale della Nuova Guinea N.O. e delle isole Salvatti, Batanta, William, ecc. secondo i rilievi originali di Lovera, Cerruti, Beccari e le esplorazioni anteriori costruita e disegnata da

- Guido Cora. Scala 1:1.000.000. — *Cosmos* (G. Cora) 3 (1875) Tav. II. — Explanatory notes in Cora G. Recenti spedizioni alla Nuova Guinea. Note sulle Tavole II e III. — *Ibid.*: 81–83.
- Carta originale della Baia di Geelvink e del litorale N.O. della Nuova Guinea secondo i rilievi di Odoardo Beccari, 1875 del Geelvink, di Duperrey, Dumont D'Urville, ecc. costrutta e disegnata da Guido Cora. Scala 1:1.800.000. — Including an inset map: Tracciato comparativo della Baia di Geelvink secondo la carta dell'Amm. Ingl. N° 2759a ed i rilievi di O. Beccari. Scala 1:4.800.000. — *Ibid.*: Tav. III. — Explanatory notes in Cora G. Recenti spedizioni alla Nuova Guinea. Note sulle Tavole II e III. — *Ibid.*: 81–83.
- Carta originale della Nuova Guinea Nord dai Monti Arfak alla Baia d'Humboldt secondo i rilievi di Odoardo Beccari, 1875–76, della nave oland. 'Soerabaja', cap. Swaan e le esplorazioni anteriori, costrutta e disegnata da Guido Cora. Scala 1:2.000.000. — Including an inset map: I Monti Arfak. Scala 1:800.000. — *Ibid.* 3 (1876) Tav. X. — Explanatory notes in Cora G. Recenti spedizioni alla Nuova Guinea. Note sulla Tavola X. — *Ibid.*: 347–349.
- Piano della Baia d'Humboldt (Telokh Lintciu) secondo i rilievi della nave oland. e 'Etna' 1858 e le ricerche di O. Beccari, 1875, di Guido Cora. Scala 1:70.000. — *Ibid.*: Tav. XI.
- Carta originale della Provincia di Sarawak, compilata sopra vari documenti e secondo le osservazioni dell'autore. — In O. Beccari, *Nelle foreste di Borneo* (1902) fig. 36 (p. 187).
- Abbozzo di carta (originale) del fiume Bintulu e suoi affluenti. — *Ibid.*: fig. 58 (p. 351).
- Carta del sistema idrografico e delle attuali divisioni politiche di Borneo, compilata sopra i documenti più recenti e le osservazioni dell'autore. — *Ibid.*: fig. 66 (p. 407).
- Carta originale degli itinerari dell'autore in Sarawak. — *Ibid.*: fig. 75 (facing page 504).
- Carta speciale della Nuova Guinea Ovest cogli itinerari di O. Beccari e L.M. D'Albertis (1872–1876) costrutta e disegnata da Guido Cora. — Including an inset map: Carta originale del viaggio di O. Beccari nel Sud Est di Celebes. 1874. Disegnata da G. Cora. — In O. Beccari, *Nuova Guinea, Selebes e Molucche* (1924) at the end of the book.
- Carta delle Isole Arù secondo i rilievi di Odoardo Beccari. Luglio 1873. — In O. Beccari, *Lettera di O. Beccari al Marchese Doria*. — *Boll. Soc. Geogr. Ital.* 10: 4–5 (1873) 64–65, at the end of the paper.
- Carta della Parte Sud-est delle Celebes secondo la relazione di O. Beccari e traccia del suo viaggio da Makassar a Kandari, Febbraio 1874. — *Ibid.*: 11 (1874) 480–488, at the end of the paper.

## Appendix 2 — Biographies of Odoardo Beccari

- BALDASSERONI, V. & D. CARAZZI. L'opera biologica di Odoardo Beccari. *Rassegna Sci. Biol.* 3 (1921) 84–88.
- BARGAGLI PETRUCCI, G. L'opera biologica di Odoardo Beccari. *Pubbl. Ist. Stud. Sup. Firenze, Sez. Sci. Fis. Nat.* In memoria di Odoardo Beccari, pp. 5–16. 1921.
- BECCARI, N. *Enciclopedia Italiana di Scienze, Lettere ed Arti*. Milano, Ist. G. Treccani, 6 (1930) 462.
- Brief Obituary, Itineraries and Bibliography — Manuscript compiled by Beccari's son Nello for *Flora Malesiana*, Oct. 1947 (in *Library Rijksherbarium, Leiden*).
- BÉGUINOT, A. *Boll. R. Soc. Geogr. Ital.* ser. 5, 12 (1923) 194–209, portr.
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- CHIOVENDA, E. Notizie biografiche. Odoardo Beccari. Annuario R. Ist. Stud. Sup. Firenze 1920-21 (1921) 155-156.
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**Appendix 3 — Accounts of Odoardo Beccari's itineraries  
in Malesia and Ethiopia**

(see also Letters and Maps)

- BECCARI, N. Brief Obituary, Itineraries and Bibliography. — Manuscript compiled by Beccari's son Nello for Flora Malesiana, Oct. 1947. (in Library Rijksherbarium, Leiden).
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- Recenti spedizioni alla Nuova Guinea. Odoardo Beccari. — Ibid.: 215–218, 265; 2 (1874–75) 2–4, 86; 3 (1875–76) 75–76.
- Viaggio di O. Beccari nel Sud-est di Celebes. — Ibid.: 2 (1874–75) 200–202, t. V (map).
- Recenti spedizioni alla Nuova Guinea. Secondo viaggio della 'Vettor Pisani'. — Ibid.: 3 (1875–76) 77–78.
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- MARTELLI, U. Odoardo Beccari. Webbia 5 (1921) 295–353, 3 maps.
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### Appendix 4 — Studies based on Odoardo Beccari's botanical collections (incomplete)

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## ABBREVIATIONS AND SIGNS

- acc. = according  
 Ak. Bis. = Aklan Bisáya (Philip. language)  
 Alf. Cel. = Alfuresse Celebes (language)  
 alt. = altitude  
 Anat. = Anatomy  
 Ap. = Apáyao (Philip. language)  
 app. = appendix, appendices  
 appr. = approximate  
 Apr. = April  
 Arch. = Archipelago  
 atl. = atlas  
*auct. div.* = *auctores diversi*; various authors  
*auct(t). mal.* = *auctores malayenses*; authors dealing with Malesian flora  
*auct(t). plur.* = *auctores plures*; several authors  
 Aug. = August  
 Bag. = Bagóbó (Philip. language)  
 basionym = original name of the type specimen; its epithet remains permanently attached to the taxon which is typified by it provided it is of the same rank.  
 Bg. = Buginese (language)  
 Bik. = Bikol (Philip. language)  
 Bil. = Bilá-an (Philip. language)  
 Bill. = Billiton  
 Bis. = Bisáya (Philip. language)  
 Bon. = Bontók (Philip. language)  
 Born. = Borneo  
 Bt = Bukit; mountain  
 Bug. = Buginese (language)  
 Buk. = Bukidnon (Philip. language)  
*c.* = *circiter*; about  
 C. Bis. = Cebu Bisáya (Philip. language)  
*cf.* = *confer*; compare  
 Chab. = Chabecáno (Philip. language)  
 citations = see references  
 cm = centimetre  
*c.n.* = see *comb. nov.*  
*comb. nov.* = *combinatio nova*; new combination  
 CS = cross-section or transversal section of an organ  
*c.s.* = *cum suis*; with collaboration  
*cum fig.* = including the figure  
*cur.* = *curante*; edited by  
 D (after a vernacular name) = Dutch  
 Daj. = Dyak (language)  
 d.b.h. = diameter at breast height  
 D.E.I. = Dutch East Indies  
*descr.* added behind a reference = means that this contains a valid description  
 diam. = diameter  
 Distr. (as an item) = Distribution  
 Distr. (with a geographical name) = District  
*ditto* = the same, see *do*  
 Div. = Division, or Divide  
*div.* = *diversus* (masc.); various  
*do* = *ditto* (Ital.); the same  
 Dum. = Dumágat (Philip. language)  
 dupl. = duplicate  
 E = east (after degrees: eastern longitude)  
 E (after a vernacular name) = English  
 Ecol. = Ecology  
 ed. = edited; edition; editor  
 e.g. = *exempli gratia*; for example  
*elab.* = *elaboravit*; revised  
*em(end).* = *emendavit*; emended  
 em(erg). ed. = emergency edition  
 Engl. = English  
*etc., &c.* = *et cetera*; and (the) other things  
*ex auctt.* = *ex auctores*; according to authors  
*excl.* = *exclusus* (masc.); excluding, exclusive of  
*ex descr.* = known to the author only from the description  
*f.* (before a plant name) = *forma*; form  
*f.* (after a personal name) = *filius*; the son  
*f.* (in citations) = figure  
 fam. = family  
 Feb(r). = February  
*fide* = according to  
 fig. = figure  
*fl.* = *flore, floret (floruit)*; (with) flower, flowering  
 For. Serv. = Forest Service  
*fr.* = *fructu, fructescit*; (with) fruit, fruiting  
 Fr. (after a vernacular name) = French  
 G. = Gunung (Malay); mountain  
 Gad. = Gaddáng (Philip. language)  
*gen.* = *genus*; genus  
*genus delendum* = genus to be rejected  
 Germ. = German  
*geront.* = Old World  
*haud* = not, not at all  
 holotype = the specimen on which the original description was actually based or so designated by the original author  
 homonym = a name which duplicates the name of an earlier described taxon (of the same rank) but which is based on a different type species or type specimen; all later homonyms are nomenclaturally illegitimate, unless conserved  
 I. = Island  
*ib(id).* = *ibidem*; the same, in the same place  
 Ibn. = Ibanág (Philip. language)  
*ic.* = *icon, icones*; plate, plates  
*ic. inedit.* = *icon ineditum, icones inedita*; inedited plate(s)  
*id.* = *idem*; the same  
*i.e.* = *id est*; that is  
 If. = Ifugáo (Philip. language)  
 Ig. = Igorot (Philip. language)  
 Ilg. = Ilongót (Philip. language)  
 Ilk. = Ilóko (Philip. language)  
*in adnot.* = *in adnotatione*; in note, in annotation  
*incl.* = *inclusus* (masc.); including, inclusive(ly)  
 indet. = indetermined  
 Indr. = Indragiri (in Central Sumatra)  
*inedit.* = *ineditus* (masc.); inedited  
*in herb.* = *in herbario*; in the herbarium  
*in litt.* = *in litteris*; communicated by letter  
*in sched.* = *in schedula*; on a herbarium sheet  
*in sicc.* = *in sicco*; in a dried state  
*in syn.* = *in synonymis*; in synonymy  
 Is. = Islands  
 Is. (after a vernacular name) = Isinái (Philip. language)  
 Ism. = Isámal (Philip. language)  
 isotype = a duplicate of the holotype; in arboreous plants isotypes have often been collected from a single tree, shrub, or liana from which the holotype was also derived  
 Iv. = Ivatán (Philip. language)  
 J(av). = Javanese (language)  
 Jan. = January  
 Jr = Junior  
 Klg. = Kalinga (Philip. language)  
 Kul. = Kuláman (Philip. language)  
 Kuy. = Kuyónon (Philip. language)  
 Lamp. = Lampong Districts (in S. Sumatra)

Lan. = Lánao (Philip. language)

lang. = language

*l.c.* = *loco citato*; compare reference

lectotype = the specimen selected *a posteriori* from the authentic elements on which the taxon was based when no holotype was designated or when the holotype is lost

livr. = livraison, part

*ll.cc.* = *l.c.* (plur.)

LS = longitudinal or lengthwise section of an organ

m = metre

M = Malay (language)

Mag. = Magindanao (Philip. language)

Mak. = Makassar, Macassar (in SW. Celebes)

Mal. = Malay(an)

Mal. Pen. = Malay Peninsula

Mand. = Mandáya (Philip. language)

Mang. = Mangyán (Philip. language)

Mar. = March

Mbo = Manóbo (Philip. language)

Md. = Madurese (language)

Minangk. = Minangkabau (a Sumatran language)

*min. part.* = *pro minore parte*; for the smaller part

mm = millimetre

Mng. = Mangguangan (Philip. language)

Morph. = Morphology

ms(c), MS(S) = manuscript(s)

Mt(s) = Mount(ains)

*n.* = *numero*; number

N = North (after degrees: northern latitude); or New (e.g. in N. Guinea)

NE. = northeast

*nec* = not

*neerl.* = Netherlands, Netherlands edition

Neg. = Negrito (Philip. language)

N.E.I. = Netherlands East Indies

neotype = the specimen designated to serve as nomenclatural type when no authentic specimens have existed or when they have been lost; a neotype retains its status as the new type as long as no authentic elements are recovered and as long as it can be shown to be satisfactory in accordance with the original description or figure of the taxon

N.G. = New Guinea

N.I. = Netherlands Indies

*no* = *numero*; number

*nom.* = *nomen*; name (only) = *nomen nudum*

*nom. al.* = *nomen aliorum*; name used by other authors

*nom. alt(ern).* = *nomen alternativum*; alternative name

*nom. cons(erv).* = *nomen conservandum*, *nomina conservanda*; generic name(s) conserved by the International Rules of Botanical Nomenclature

*nom. fam. cons.* = *nomen familiarum conservandum*; conserved family name

*nom. gen. cons.* = see *nomen conservandum*

*nom. gen. cons. prop.* = *nomen genericum conservandum propositum*; generic name proposed for conservation

*nom. illeg(it).* = *nomen illegitimum*; illegitimate name

*nom. leg(it).* = *nomen legitimum*; legitimate name

*nom. nov.* = *nomen novum*; new name

*nom. nud.* = *nomen nudum*; name published without description and without reference to previous publications

*nom. rej(ic.)* = *nomen rejiciendum*; name rejected by the International Rules of Botanical Nomenclature

*nom. seminudum* = a name which is provided with some unessential notes or details which cannot be considered to represent a sufficient description which is, according to the International Rules of Botanical Nomenclature, compulsory for valid publication of the name of a taxon

*nom. subnudum* = *nomen seminudum*

*nom. superfl.* = a name superfluous when it was published; in most cases it is a name based on the same type as an other earlier specific name

*non* followed by author's name and year, not placed in parentheses, and put at the end of a citation = means that this author has published the same name mentioned in the citation *independently*. These names (combinations) are therefore homonyms.

Compare 56b line 5–4 from bottom. The same can happen with generic names.

(*non* followed by abbreviation of author's name) before a reference (citation) headed by an other author's name = means that the second author has misinterpreted the taxon of the first author.

Compare p. 419a under species 47 the synonym *H. celebica*. DIELS misapplied the name *H. celebica* as earlier described by BURCK.

*non al.* = *non aliorum*; not of other authors

*non vidi* = not seen by the author

*nov.* = *nova* (femin.); new (species, variety, etc.)

Nov. = November

n.s. = new series

*n. sp.* = *nova species*; new species

*n. (sp.) prov.* = *nomen (specificum) provisorium*; provisional new (specific) name

*n.v.* = *non vidi*; not seen

NW. = northwest

Oct. = October

*op.cit.* = *opere citato*; in the work cited

p. = *pagina*; page

P. = Pulau, Pulu (in Malay); Island

Pal(emb.) = Palembang

Pamp. = Pampangan (Philip. language)

Pang. = Pangasinan (Philip. language)

paratype = a specimen cited with the original description other than the holotype

*part. alt.* = for the other part

P. Bis. = Panay Bisaya (Philip. language)

P.I. = Philippine Islands

pl. = plate

*plurim.* = *plurimus*; most

*p.p.* = *pro parte*; partly

*pr. max. p.* = *pro maxima parte*; for the greater part

*pro* = as far as is concerned

*prob.* = *probabiliter*; probably

*prop.* = *propositus*; proposed

Prov. = Province

*pr.p.* = *pro parte*; partly

pt = part

*quae est* = which is

*quoad* basionym, syn., specimina, etc. = as far as the basionym, synonym(s), specimen(s), etc. are concerned

references = see for abbreviations the list in vol. 5, pp. cxlv–clxv

Res. = Residency or Reserve

resp. = respectively



## Abbreviations and signs

S = south (after degrees: southern latitude)  
 S (after a vernacular name) = Sundanese (language)  
 Sbl. = Sambali (Philip. language)  
 SE. = southeast  
 sec. = *secus*; according to  
 sect. = *sectio*; section  
 sens. ampl. (ampliss.) = *sensu amplo (amplissimo)*; in a wider sense, in the widest sense  
 sens. lat. = *sensu lato*; in a wide sense  
 sens. str. (strictiss.) = *sensu stricto (strictissimo)*; in the narrow sense, in the narrowest sense  
 Sept. = September  
 seq., seqq. = *sequens, sequentia*; the following  
 ser. = series  
 s.l. = *sensu lato*; in a wide sense  
 S.-L. Bis. = Samar-Leyte Bisaya (Philip. language)  
 Sml. = Samal (Philip. language)  
 s.n. = *sine numero*; (specimen) without the collector's number  
 Sp. = Spanish (language)  
 sp(ec). = *species*; species  
 specim. = specimen(s)  
 sphalm. = *sphalmate*; by error, erroneous  
 spp. = *species*; species (plural)  
 Sr = Senior  
 s.s. = see *sens. str.*  
 ssp. = *subspecies*; subspecies  
 s.str. = see *sens. str.*  
 stat. nov. = *status nova*; proposed in a new rank  
 Sub. = Subánum (Philip. language)  
 subg(en). = *subgenus*; subgenus  
 subsect. = *subsectio*; subsection  
 subsp. = *subspecies*; subspecies  
 Sul. = Súlu (Philip. language)  
 Sum. E.C. = Sumatra East Coast  
 Sum. W.C. = Sumatra West Coast  
 Suppl. = Supplement  
 SW. = southwest  
 syn. = *synonymum*; synonym  
 synonyms = the names of taxa which have been referred to an earlier described taxon of the same rank and with which they have been united on taxonomical grounds or which are bound together nomenclaturally  
 syntypes = the specimens used by the original author when no holotype was designed or more specimens were simultaneously designated as type  
 t. = *tabula*; plate  
 Tag. = Tagalog (Philip. language)  
 Tagb. = Tagbanúa (Philip. language)  
 Tagk. = Tagaká-ólo (Philip. language)  
 Tapan. = Tapanuli (in NW. Sumatra)

taxon = each entity throughout the hierarchic ranks of the plant kingdom which can be described and discriminated from other taxa of the same rank  
 Taxon. = Taxonomy  
 Tg = Tandjung (Malay); cape  
 Ting. = Tinggián (Philip. language)  
 Tir. = Tirurai (Philip. language)  
 transl. = translated  
 type = each taxon above the rank of a species is typified by a type belonging to a lower rank, for instance a family by a genus, a genus in its turn by a species; a species or infraspecific taxon is typified by a specimen. The name of a taxon is nomenclaturally permanently attached to its type; from this it cannot be inferred that the type always represents botanically the most typical or average structure found in the circumscription of the taxon.  
 type specimen = the specimen or other element to which the name of a species or infraspecific taxon is (nomenclaturally) permanently attached; botanically a type specimen is a random specimen on which the name was based by description. Therefore, it does not need to represent the average or most typical representative of a population. See holotype, isotype, lectotype, syntype, paratype, and neotype  
 typ. excl. = *typo excluso*; type excluded  
 typ. incl. = *typo incluso*; type included  
 typus = see type and type specimen  
 var. = *varietas*; variety  
 var. nov. = *varietas nova*; new variety  
 Vern. = Vernacular  
 vide = see  
 viz. = *videlicet*; namely  
 vol. = volume  
 W = west (after degrees: western longitude)  
 Yak. = Yakán (Philip. language)  
 ± = about  
 & = and  
 Ø = diameter  
 ♂ = male (flower, etc.)  
 ♀ = female (flower, etc.)  
 ♂, ♀ = bisexual (flower)  
 (♂) (♀) = dioecious with unisexual flowers  
 (♂ ♀) = monoecious with unisexual flowers  
 (♂ ♀) = polygamous  
 (♂ ♀) = polygamous  
 ∞ = many  
 > = more than (in size, number, etc.)  
 < = less than (size, number, etc.)  
 × 2/5 = 2/5 of natural size  
 × *montana* = means that the epithet *montana* is that of a hybrid



## ARALIACEAE—I (W. R. Philipson, Christchurch)<sup>1</sup>

Trees, shrubs, lianas, woody epiphytes or (*extra-Mal.*) more rarely herbs. Branches usually stout with leaves clustered at their ends; armed or unarmed; glabrous or with a tomentum of stellate or simple hairs; buds either covered by the stipular sheaths of leaves or by cataphylls. *Leaves* spiral or rarely opposite or in whorls; petiole usually clasping the stem; stipules either distinct or united into a ligule or absent (in *Osmoxylon* the petiole bears  $\pm$  elaborate crests around its base); lamina digitately compound or pinnate, sometimes to the second or third degree, or simple, when either entire or pinnately or palmately lobed, margin entire or dentate. *Inflorescence* terminal or more rarely lateral; either simple or compound racemes or spikes, or more commonly of umbels or capitula, either solitary or arranged in compound umbels or panicles; bracts usually small and caducous; pedicel either articulated with the flower or continuous with it. *Flowers* hermaphrodite or hetero-sexual, sometimes dioecious; actinomorphic. *Calyx* lobes small, or reduced to a rim, or rarely absent. *Petals* 3 to numerous, often 5, sometimes fused into a calyptra, or forming a tube with spreading lobes (*Osmoxylon*), valvate or imbricate in bud, usually with a broad base but rarely narrowed below. *Stamens* usually as many as the petals and alternating with them, or twice as many, or indefinite; filaments inserted at the edge of the disk; anthers dorsifixed, introrse, pollen sacs 4 or rarely 8. *Ovary* inferior, half inferior, or very rarely (*extra-Mal.*) superior, 1- to many-celled, the top of the ovary usually a fleshy disk; styles and stigmas as many as the cells, either connate or wholly or partially free. *Ovules* solitary, pendulous, anatropous, with the raphe ventral. *Fruit* baccate or drupaceous, exocarp usually fleshy, endocarp forming cartilaginous or membranaceous pyrenes around the seeds. *Seeds* one per pyrene, with a small embryo within smooth or ruminate endosperm.

**Distribution.** About 50 genera with a roughly estimated 1150 species, ranging mainly in the warmer parts of both hemispheres (especially in montane zones), a small number in or extending to cool-temperate regions. With the exception of SE. Asia, the family and its centres of distribution are largely found within the land masses derived from ancient Gondwanaland. In Malesia 17 genera with a total (excluding *Schefflera*) of 117 species in 16 genera. (The largest genus, *Schefflera*, with an estimated 250 species for the region, is omitted from this account.)

Three genera are endemic to Malesia (or nearly so). One of these, *Anakasia* (related to *Polyscias*) is of very local distribution in West New Guinea; the two others, *Harmsioplanax* (Java, Lesser Sunda Is., Celebes, to New Guinea) and *Aralidium* (Malay Peninsula, Sumatra and Borneo, with an extension to Thailand) are more widely distributed.

Five other genera have their main centres of distribution within Malesia. Two of these extend further eastwards: *Mackinlaya* ranges from the Philippines and Celebes through New Guinea to the Solomon Is. and NE. Australia; *Osmoxylon* occurs from Botel Tobago (Taiwan) and the Marianas to Borneo, the Philippines, Celebes, the Moluccas, New Guinea to the Solomon Is. and the New Hebrides. A third, *Trevesia*, is confined to western Malesia (Lesser Sunda Is., Java, Borneo, Sumatra, and Malaya), with an extension into the Asian mainland. Wider ranges are recorded for *Gastonia* (widespread in Malesia to the Solomon Is.) with an additional range in the Seychelles, Mascarenes, and Madagascar (but not East Africa as previously reported) and *Arthrophyllum* (all over Malesia with extensions to Thailand, Laos, the Nicobar Islands, and New Caledonia).

A significant element in the Malesian representation of the family consists of six genera which occur mainly in SE.-E. Asia, two of which further extending to the Americas, *viz* *Aralia* (in

(1) The genus *Schefflera* is omitted and will be treated separately by Dr D. G. Frodin (University of Papua New Guinea). I enjoyed his assistance in drawing the general chapters.



America south to Mexico) throughout Malesia, and *Dendropanax* (tropical America) in West Malesia (Sumatra, Malay Peninsula, Borneo). The remaining four genera range in Malesia as follows: *Macropanax* and *Brassaiaopsis* in Malay Peninsula, Sumatra and Java, *Acanthopanax* in Malay Peninsula, Sumatra and the Philippines, and *Pentapanax* only in East Java.

Only one genus, *Delarbrea*, has its main centre of distribution to the east of Malesia (Melanesia, mostly New Caledonia) and Queensland, and extends through New Guinea to the Moluccas and Lesser Sunda Is. as far west as Timor.

Two other genera have wider distributions. *Schefflera*, including several segregate genera, is pantropical although with but few representatives (13) on the African mainland. However, the several sections of *Schefflera* as redefined by FRODIN (1970, 1975) often show distinctive regional distributions paralleling those of several of the other genera. The type section ranges from the New Hebrides to Samoa and New Zealand, including Fiji and New Caledonia.

*Polyscias* is widely dispersed in the Old World tropics from the African mainland eastwards to the Society Is. and Australia, but with only a few species in SE. Asia and western Malesia. As in *Schefflera*, the diverse series of species comprising the genus show distinctive regional distribution patterns, with the type series being mainly Melanesian and East Malesian (in West Malesia it is only cultivated or adventive).

As said above several Malesian genera extend into, or have their main centres in, mainland Asia, but only *Polyscias* (in Sri Lanka) and *Schefflera* are shared with Africa and the same genera (with *Gastonia*) with Madagascar. Only *Polyscias* and *Gastonia* occur in the Mascarene Islands and *Gastonia* and *Schefflera* in the Seychelles. Two other genera are restricted to mainland Africa. *Hedera* of temperate Eurasia extends to the Canary Islands. The Americas have two (or three) distinctive endemic genera with recognizable affinities, as well as disjunct groups of the Australasian *Pseudopanax*, the Asiatic *Pentapanax* and *Dendropanax* and (in North America) *Oplopanax*, *Aralia* and *Panax*, all very closely related to those in East Asia; there are also distinctive sections of *Schefflera* in the neotropics which are nearer those in Africa than in Asia. Many distinctive endemic genera (or parts of the larger genera) occur in Oceania, the New Zealand region and Australia, some of them taxonomically very isolated.

The ratio of species : genus is here estimated as 23 : 1, but if the very large genus *Schefflera* is not accounted for this reduces to 13 : 1. Some 30 genera have five or fewer species; in view of the considerable insular endemism at generic or infrageneric level, weak intercontinental links, and great distinctiveness of many genera (even though small), the family is surely of great antiquity, although much of the available palaeobotanical evidence requires re-evaluation (cf. DILCHER & DOLPH, 1970). Many fossils previously referred to *Oreopanax* must now be placed in *Platanaceae* (DOYLE, pers. comm.). *Dendropanax* has reliably been reported from Tertiary deposits in both Europe and North America where it is now absent (DILCHER & DOLPH, *l.c.*).

*References:* DILCHER & DOLPH, *Amer. J. Bot.* 57 (1970) 153–160; FRODIN, The complex of *Cephaloschefflera* in *Schefflera* (*Araliaceae*), Thesis, Cambridge, U.K. (1970); J. Arn. Arb. 56 (1975) 427–448.

*Ecology.* Malesian *Araliaceae* are usually small trees, shrubs, or lianas, with a number being sometimes or always epiphytic (especially in *Schefflera*), and where terrestrial usually in the undergrowth or lower stories of rain-forest, seldom reaching over 20 m. A remarkable exception is provided by the two species of *Gastonia*; of these *G. spectabilis* (HARMS) PHILIPSON of Papuaia can attain the great height of 40 m with a stem of 1.75 m  $\varnothing$ ; it is the largest araliad known and is of very striking appearance. Fig. 27.

Araliads are almost always found scattered in forest and other vegetation, at least in Malesia. However, a notable exception is provided by the tree *Schefflera rugosa* (BL.) HARMS in Java; LAM (1924) recorded its gregarious occurrence on the volcanic cone of Mt Slamet in Central Java where it is co-dominant with the pyrophilous *Albizia lophantha* BTH. in elfin forest between 2500–3050 m, above which it gives way to the open, rocky, treeless slopes below the summit (3428 m). It is also gregarious on Mt Tjeremai in West Java, where LAM (1925) noted that above some 2650 m a low forest dominated by this species replaces the high forest of *Dacrycarpus imbricatus*; this low forest extends to c. 3000 m. On the Gedeh-Pangrango complex above Puntjak Pass in West Java *Schefflera rugosa* is frequent in forest borders. On Mt Ulu Kali in Malaya, east of Kuala Lumpur, *S. nervosa* (KING) VIG. is common in young regrowth along the main road

below the Genting Highlands hotel/casino complex from 1300–1600 m. This pioneering tendency is shared by a number of other species in the genus, especially in montane parts of Papuaia. Many of these species are terrestrial as pioneers or in secondary formations, but epiphytic in closed forest (and then often much more scattered).

Gregarious occurrence, usually in pioneering situations or in forest borders, has also been observed in the various species of *Harmsioplanax*; STEUP (1938) observed *H. aculeatus* (BL.) WARB. ex BOERL. as a characteristic pioneer in grass thickets on hills in SW. Celebes. *H. harmsii* K. SCH. behaves similarly around Wau, Bulolo, and Sogeri (Rouna) in Papua New Guinea, especially in narrow intermontane valleys, while *H. ingens* PHILIPSON can be locally abundant in open situations in the highlands of New Guinea. *Gastonia spectabilis* (HARMS) PHILIPSON can be locally frequent as a pioneer in hill areas, e.g. around Bulolo and on the Madang-Ramu Divide; while *Polyscias elegans* (C. MOORE & F.v.M.) HARMS is frequently seen in stable monsoon scrub and forest borders in the Port Moresby region and *P. ledermannii* HARMS can be an exceedingly common regrowth tree in cut-over montane forest subject to frequent cloudiness and rain.

In the subalpine zone of New Guinea BRASS (1941) found two species of *Schefflera* conspicuous in the stunted forest of *Xanthomyrtus-Vaccinium-Papuacedrus-Phyllocladus* between 3200–3800 m on Mt Wilhelmina. From Lake Habbema upwards, the characteristic overtopping tree is *S. altigena* FRODIN (sect. *Brassaia*), with its large foliage contrasting sharply with the surrounding microphyllous vegetation; at higher altitudes it gives way to *S. pagiophylla* HARMS (*S. falcata* PHILIPSON), a species of uncertain affinities. *Schefflera chimbuensis* FRODIN and *S. straminea* FRODIN are likewise often seen in forest borders on Mt Wilhelm and Mt Giluwe respectively in Papua New Guinea.

In contrast to the large and conspicuous species of *Schefflera*, many others are more or less shade-loving epiphytes or vines of lower storeys within the forest, although they may occur in sunnier situations where clouding is frequent (*S. singularis* B. C. STONE on Mt Ulu Kali). One group of species in New Guinea is almost limited to perhumid moist or wet rain-forests and usually are small epiphytic shrubs or even herbs (*S. gemma* FRODIN). A few species are conspicuous rosette-trees of the forest understorey (*S. stahlia* (WARB.) FRODIN).

*Climate.* In Malesia *Araliaceae* for the most part shun regions subject to a seasonal climate; all species are evergreen. A few exceptions include *Schefflera thaumasiantha* HARMS from open savanna in the hill zone in SE. New Guinea and *S. actinophylla* (ENDL.) HARMS as a gallery tree in seasonal parts of southern New Guinea, but especially *Harmsioplanax aculeatus* whose range is for the greater part subject to an annual drought period; in addition to SW. Celebes, it is also frequent on old lava-streams on Mt Idjen in East Java together with *Wightia*, *Casuarina junghuhniana*, *Dodonaea*, and *Wendlandia*, and is one of the few araliads in the Lesser Sunda Islands.

With respect to altitude, most *Araliaceae* occur in the lowland, hill and montane zone below 2300 m. The only genera of which all Malesian representatives occur in the hills and mountains above 1000 m are *Pentapanax* and *Dendropanax*, but even these do not exceed 3000 m. Only certain species of *Schefflera* and *Harmsioplanax* continue upwards much higher, especially in New Guinea where the highest known record belongs to *S. pagiophylla* HARMS on the Carstensz complex, where F. J. WISSEL found it in 1936 at 3900 m.

*Flower biology.* Little has been recorded about the floral biology of the family in Malesia, but BECCARI's account (1878) of the 'false fruits' of *Osmoxylon* (including *Boerlagiodendron*) serving to attract doves which are assumed to effect pollination has become a classic description and example of ornithophily.

Heterosexual flowers, usually involving combinations of perfect and male flowers, occur frequently but understanding will require intensive study in the living state.

Though flowers are not generally showy and often veritably inconspicuous, the disk produces abundant nectar. They also may spread a rather disagreeable scent, somewhat spermiatic, that in *Schefflera rugosa* resembling that of *Ligustrum*. For this species DOCTERS VAN LEEUWEN (1933) observed on Mt Gedeh, West Java, only rare visits (notably by *Diptera*), but assumed that cross-pollination will be the rule. Flowers (at least those of *Fatsia*) will also be visited by *Hymenoptera*. In *Schefflera stahlia* (WARB.) FRODIN, the thick fleshy flowers, numerous stamens, and position of the inflorescence below the rosette of leaves all point to bat pollination.

*Dispersal* in the family takes place generally by fruit-fall; but as fruits are baccate or (more



usually) drupaceous, they will also be eaten by birds (for the most part) and bats, as recorded by RIDLEY (1930) for *Aralia*, *Hedera*, and *Schefflera*. The black fruits of *Schefflera* sect. *Brassaia* in New Guinea and Australia are especially popular with birds. The hooked mericarps of *Harmsioplanax* are exceptional.

Seed germination is most likely after the seed having passed the gut of a bird or after mastication of the fruit by a bat.

*References:* BECCARI, Malesia 1 (1878) 193–198; BRASS, J. Arn. Arb. 22 (1941) 271–342, esp. 318, 320, 323, 327; DOCTERS VAN LEEUWEN, Verh. Kon. Ak. Wet. A'dam sect. 2, 31 (1933) 195; H. J. LAM, Trop. Natuur 13 (1924) 20; *ibid.* 14 (1925) 6; RIDLEY, Disp. (1930); STEUP, Trop. Natuur 27 (1938) 142.

**Morphology.** Most erect *Araliaceae* are sparingly branched or even unbranched; their limbs are upright and the often massive, easily broken twigs generally bear rosettes of big, long-stalked leaves which leave large scars when they fall. Few form a true crown (*Arthrophyllum*, *Gastonia*, some species of *Schefflera* and *Polyscias*), while the others often look like elongated and grotesque shrubs with a candelabrum-like framework. Branches in most *Araliaceae* are entirely orthotropic; generally speaking, the plants would fit into the so-called Holttum, Corner, Tomlinson, Chamberlain and Leeuwenberg models of HALLÉ *c.s.* (1970, 1978), or their intermediates.

*Aralia scandens* (MERR.) HA is a true climber. Epiphytic species only occur in the genus *Schefflera*; it is not yet recorded that any of them may appear to turn into a hemi-epiphytic habit.

*Hedera* (not native in Malesia) is almost the only genus with differentiated shoots and marked vegetative dimorphism.

A preliminary account of shoot-morphology in the family has been given by PHILIPSON (1978), but much further field work is required in this area. Vegetative buds may be either proleptic or sylleptic; in the resting phase such buds may be covered by the clasping bases of foliage leaves (*Osmoxylon*, *Schefflera*) or (more rarely) specialized cataphylls (*Acanthopanax*). In both types of bud the primordia and young leaves may be covered by exudations of resinous slime.

There is so far little recorded evidence of the changes in leaf shape and configuration during the somatic phase of the life cycle known in many araliads in other parts of the world; however, recent observations in New Guinea made by FRODIN suggest that heteroblastism does occur, although its manifestation is not constant for a given species. Distinctive juvenile and intermediate foliage has been found in *Schefflera eriocephala* HARMS and (to a lesser extent) in *S. stolleana* HARMS. Other examples are seen in *Brassaiopsis*, *Trevesia* and *Schefflera* subg. *Agalma* (*S. aromatica* (BL.) HARMS; *S. nervosa* (KING) VIG.); juvenile leaves of some of these are preserved in Herbarium Bogoriense. In *Harmsioplanax*, the configuration of the leaves changes abruptly just below the inflorescence, a phenomenon paralleled in some other genera although less dramatically. In *Mackinlaya celebica* (HARMS) PHILIPSON and *M. schlechteri* (HARMS) PHILIPSON, leaf polymorphism is very marked with the result that in the past several 'paper species' have been described on too limited a range of material; in this revision many reductions have been made.

*References:* HALLÉ & OLDEMAN, Essai sur l'architecture et la dynamique de croissance des arbres tropicaux, Paris (1970); HALLÉ, OLDEMAN & TOMLINSON, Tropical trees and forests: an architectural analysis, Berlin (1978); PHILIPSON in Tomlinson & Zimmermann (eds.), Tropical trees as living systems (1978) 269–284.

**Anatomy.** General accounts of the vegetative anatomy of the ivy family are given by GÜSSOW (1900), VIGUIER (1906, 1909) and METCALFE & CHALK (1950). Secretory canals are characteristic of the stems and leaves, but are absent from *Aralidium*. A comparison of the wood anatomy of *Araliaceae* and *Cornaceae* is made by PHILIPSON (1967), and an extensive account of vegetative anatomy in the context of woody *Umbellales* was provided by RODRIGUEZ (1957, 1971). The xylem of the former family is characterized by fibres with small, simple pits, and the presence of scalariform and reticulate perforation plates in the vessel elements (as opposed to simple perforations) is thought to be a less advanced feature. Recent special reports bearing on taxonomy include: on stomatal development (INAMDAR *c.s.*, 1969); on sievetube plastids (BEHNKE, 1972), and on epidermal papillae (BUI, 1974).

**Floral anatomy** is discussed by BAUMANN-BODENHEIM (1955), PHILIPSON (1967, 1970) and especially by EYDE & TSENG (1971). Embryological characteristics of the family have been re-



viewed by DAVIS (1966) as well as by RAO (1972). The single pendulous anatropous ovule has the funiculus and ovular vascular bundle axial (PHILIPSON, 1970). The embryo is small in a mass of endosperm (MARTIN, 1946; GRUSHVITZKY, 1967).

*References:* BAUMANN-BODENHEIM, Bull. Soc. Bot. Suisse 65 (1955) 481–510; BEHNKE, Bot. Rev. 38 (1972) 155–197; BUI NGOC-SANH, Bull. Mus. Hist. Nat. Paris III, Bot. 18 (1974) 85–91 (whole no 271); DAVIS, Systematic embryology of the angiosperms, New York (1966); EYDE & TSENG, J. Arn. Arb. 52 (1971) 205–239; GRUSHVITZKY, Proc. Int. Symp. Physiol. Ecol. & Biochem. of Germination (ed. H. Borris) (1967); GÜSSOW, Beiträge zur vergleichende Anatomie der *Araliaceae*, Thesis, Breslau (Wrocław) (1900) 67 pp., illus.; INAMDAR, GOPAL & CHOCHAN, Ann. Bot. n.s. 33 (1969) 67–73; MARTIN, Amer. Midl. Nat. 36 (1946) 513–660; METCALFE & CHALK, Anatomy of the dicotyledons II, Oxford (1950); PHILIPSON, New Zeal. J. Bot. 5 (1967) 134–165; in Robson, Cutler & Gregory (eds.), New research in plant anatomy, London (1970) 87–100; RAO, Phytomorphology 22 (1972) 75–87; RODRIGUEZ, Univ. Calif. Publ. Bot. 29 (1957) 145–318; in Heywood (ed.), The biology and chemistry of the *Umbelliferae*, London (1971) 63–91; VIGUIER, Ann. Sci. Nat. Bot. IX, 4 (1906) 1–209; *ibid.* IX, 9 (1909) 305–405.

*Palynology.* Palynological studies of Malesian *Araliaceae* include: on *Gastonia* (TSENG, 1971); on *Tupidanthus* and *Plerandra* (= *Schefflera*) (TSENG, 1973); on *Osmoxylon* (as *Boerlagiodendron*) (TSENG, 1974) and on *Schefflera* (TSENG & SHOUP, 1978). A detailed consideration of the relations of Araliaceous pollen to those in other orders is given by HIDEAUX & FERGUSON (1976), and of the affinities of *Klotzschia* (*Umbelliferae*/*Hydrocotyloideae*) to *Araliaceae* by SHOUP & TSENG (1977). To date, much useful new evidence has been made available, but better correlation with other classes of attributes is required.

*References:* HIDEAUX & FERGUSON in Ferguson & Muller (eds.), The evolutionary significance of the exine, London (1976); SHOUP & TSENG, Amer. J. Bot. 64 (1977) 461–463; TSENG, Amer. J. Bot. 58 (1971) 505–516; Grana 13 (1973) 51–56; Amer. J. Bot. 61 (1974) 717–721; TSENG & SHOUP, Amer. J. Bot. 65 (1978) 384–394.

*Chromosome numbers.* Lists of chromosome numbers for members of *Araliaceae* are given by DARLINGTON & WYLIE (1955), SHARMA & CHATTERJI (1964) and BOLKOVSKIKH *c.s.* (1969). The family shows considerable constancy of the basic number of  $x = 12$ , although  $x = 11$  has been recorded for one non-Malesian group of *Schefflera*. The implications of chromosome data on the wider relationships of the *Araliaceae* are discussed by MOORE (1971).

*References:* BOLKOVSKIKH *c.s.*, Chromosome numbers of flowering plants, Leningrad (1969); DARLINGTON & WYLIE, Chromosome atlas of flowering plants, ed. 2, London (1955); MOORE in Heywood (ed.), The biology and chemistry of the *Umbelliferae*, London (1971) 233–255; SHARMA & CHATTERJI, Cytologia 29 (1964) 1–12.

*Phytochemistry.* Information on the chemistry of the *Araliaceae* should be sought in HEGNAUER (1964, 1978) where references to original sources are given. The family is characterized by the occurrence of essential oils and resins in canals and by the presence of polyacetylenic compounds (especially falcarinone-type), triterpenic sapogenins of the oleanene-, ursene- and dammarene-types, seed oils with petroselinic acid, and by the absence of true tannins. The chemistry of the family fully confirms its close relationship with the *Umbelliferae* and also more distantly with the *Pittosporaceae* and the *Compositae* (HEGNAUER, 1969, 1971; BOHLMANN, 1971). The rareness of flavones and the predominance of flavonols in *Araliaceae* suggests closer relationship with two of the three subfamilies of the *Umbelliferae*, flavones having not yet been found in *Hydrocotyloideae* and *Saniculoideae* (HARBORNE, 1971). The absence of iridoid substances and true tannins and the presence of polyenes, petroselinic acid and isoprenylated coumarins in the *Umbellales* contrasts with the *Cornales* (HEGNAUER, 1969; JENSEN *c.s.*, 1975), and this led to a suggestion that the *Umbellales* and *Cornales* had to be separated (BATE-SMITH *c.s.*, 1975), an argument with increasing support from other lines of inquiry. However, insufficient evidence appears to be yet available for the detection of possible lines of relationship within the *Araliaceae*.

*References:* BATE-SMITH *c.s.* Biochem. Syst. Ecol. 3 (1975) 79–89; BOHLMANN in Heywood (ed.), The biology and chemistry of the *Umbelliferae* (1971) 279–291; HARBORNE, *l.c.* 293–314; HEGNAUER, Chemotaxonomie der Pflanzen 3 (1964); in Harborne & Swain (eds.), Perspectives in phytochemistry (1969) 121–138; in Heywood (ed.), The biology and chemistry of the *Umbelli-*

*ferae* (1971) 267–277; in Cauwet-Marc & Carbonnier (eds.), *Les Umbellifères. Contributions pluridisciplinaires à la systématique*. Perpignan (1978) 335–363; JENSEN, NIELSEN & DAHLGREN, Bot. Notis. 128 (1975) 148–180.

**Taxonomy.** The *Araliaceae* are on all grounds closely connected with the *Umbelliferae*, a very large but mainly temperate and tropical-montane group comprising mostly aromatic herbs with a restricted floral scheme. It seems likely that the ancestors of the ivy family were the woody tropical stock from which the herbaceous *Umbelliferae* evolved under the rigours of cooler climates (CORNER, 1940) with the arborescent *Heteromorpha* of upland Africa and *Myrrhidendron* in Central and South America, both in the subfamily *Apioideae*, perhaps representing relics of the transition on account of the presence of a number of attributes primitive for the family (RODRIGUEZ, 1957); on the other hand, the umbellifers may have originated as megaherbs on tropical mountains (PHILIPSON, 1978). A few *Araliaceae* genera exhibit some features characteristic of *Umbelliferae*, such as *Harmsiopanax*, *Mackinlaya*, and especially *Myodocarpus* (from New Caledonia) and *Stilbocarpa* (from southern New Zealand and associated 'subantarctic' islands).

This led HARMS (1898) to show three different lines leading from *Araliaceae* to *Umbelliferae*, suggesting that considerable overlap between the families existed; more recently RODRIGUEZ (1971) again called attention to this phenomenon and THORNE (1968, 1973) has gone further by merging *Umbelliferae* into *Araliaceae* (a step also advocated by HALLIER *f.* in 1905) and assuming the three subfamilies of the former to have arisen separately, perhaps in different parts of the world at different times, from proto-*Araliaceae* ancestors. However both he and RODRIGUEZ have concluded in agreement with CORNER (*l.c.*) and BAUMANN-BODENHEIM (1946) that the *Araliaceae sensu stricto*, "because of their greater evolutionary breadth and their retention of many more primitive features, would seem closest to the proto-araliad stock" (THORNE, 1973).

Nevertheless, the concept of *Araliaceae* as a separate natural family appears to serve a useful purpose and has been retained for this Flora. An isolated, doubtfully included genus is the West Malesian *Aralidium*; it is the only genus lacking resin ducts but it would be equally anomalous in the *Cornaceae* to which it has also been referred. It shows some resemblance with the New Zealand genus *Griselinia*, usually relegated to the *Cornaceae*, be it as a marginal member (PHILIPSON, 1967).

**Subdivision.** Since the first significant family monograph by SEEMANN (1868), several systems have been proposed which, taken together, are notable for their lack of consistency. This results from a lack of agreement on the relative importance of the comparatively minor structural and gross anatomical features of reproductive parts traditionally used and by conflicting claims on the relative 'antiquity' of polymery *versus* pentamery. Until recently, there has been for *a priori* reasons (*cf.* EYDE, 1975) little recognition of the potential value of vegetative features and their acceptance as valid evidence for a system; and information from wood anatomy, floral histology, palynology, karyology, phytochemistry, and other areas is only beginning to be utilized. While woodiness is generally accepted as a primitive feature in *Araliaceae*, the impact of the work of CORNER and others on tree structure and growth rhythms (summarized in HALLÉ, OLDEMAN & TOMLINSON, 1978; see also BORCHERT, 1969; HLADIK, 1970; PHILIPSON, 1978) has still to be fully assimilated. Much more work is also required on inflorescences, although FRODIN (1970), PHILIPSON (1970b) and others have made a beginning. The monothetic interpretation of most attribute states usual in systems of the family was first challenged by BAUMANN-BODENHEIM (*l.c.*) who considered that phyletic changes could have taken place in parallel; and EYDE & TSENG (1969) showed that at least some supposedly unidirectional sequences were reversible. This has tended to reduce the supposed importance of many of the traditional attributes, with a consequent reduction in the number of genera.

Sufficient evidence is not yet available, however, for the construction of a more balanced, polythetically based system of the family, and the long-standing subdivision proposed by HARMS (1898) into three tribes, *Schefflereae*, *Aralieae*, and *Mackinlayeae*, based monothetically on the structure and aestivation of the perianth, is retained. In spite of its now recognized imperfections, it is more valid than the systems of VIGUIER (1906) and HUTCHINSON (1967) and remains the most widely accepted. Some steps towards the formulation of a new system on polythetic principles have been taken by EYDE & TSENG (1971: 221) who make a fundamental distinction based on



basic leaf-organization (either pinnate or palmate) and recognize the heterogeneity of HARMS' *Araliaceae*; however, this system was deliberately not completely developed.

*Generic delimitation.* Generic limits within the *Araliaceae* have long been unstable. As in the *Umbelliferae*, the flower conforms to a simple and relatively uniform pattern throughout most of the family and systematists have resorted to small technical differences to delimit genera. HARMS recognized 51 genera, while VIGUIER, little more than a decade later, recognized 80; HUTCHINSON distinguished 84 genera but with criteria very differently weighted as compared with VIGUIER. Nevertheless, in Malesia as elsewhere there are several distinctive and very natural genera, including *Harmsioplanax*, *Aralidium*, *Osmoxylon*, *Anakasia*, *Mackinlaya*, *Arthrophyllum*, *Delarbrea*, and *Trevesia*. Many other genera in the family, including those Malesian ones not noted above, are mutually less distinctive and delimitation is based on various combinations of a number of attributes which have been subject to many different standards of weighting and interpretation. These include: petals valvate or imbricate; pedicel articulated or not; leaves digitately compound, pinnate, or simple; stamen and locule number and the relationship of these numbers; style free or connate; endosperm ruminant or not; and thorns present or not.

The present treatment is characterized by a number of generic reductions or exclusions; only one genus described since 1900 has been retained (*Anakasia*). *Hederopsis* is united with *Macropanax*, a genus with a very similar facies and (in part) overlapping range and which was separated merely on the number of cells in the ovary and variations in inflorescence structure. *Wardenia* has been united with *Brassaiopsis* because apart from its simple palmately veined leaves there are no differences; better material collected in recent years has provided evidence that the ovary is in fact 2-locular, but that one ovule aborts and the fruit is as a result 1-seeded. *Acanthophora* differs from *Aralia* only in habit (VAN STEENIS, 1948). PHILIPSON (1951) already regarded *Anomopanax* as insufficiently distinct from the older *Mackinlaya*, a union retained here. The same author (1973) combined *Boerlagiodendron* with the earlier described *Osmoxylon* as a number of species intermediate between the two genera had come to light. The Malesian species formerly included in *Tetraplasandra* as well as *Peckelioplanax* were likewise by PHILIPSON (1970a) reduced to two species of *Gastonia*; but it should be noted that in Malesia as on the SW. Indian Ocean islands this genus is very close to *Polyscias*, particularly the very similarly ranging *sect. Eupteron* (*P. nodosa*, *P. ledermannii*, etc.).

The two largest Malesian genera are herein both treated in a wider sense. *Polyscias* includes as its type section a distinctive Melanesian/Micronesian group of species which in the wild state extends into eastern Malesia and the Philippines, and in cultivation further west. The remainder of the genus as represented in Malesia comprises some rather distinctive species, several of which have been given generic rank (*Eupteron*, *Kissodendron*, and *Palmeriandendroekia*). If the name *Polyscias* were to be confined to the type-section of the genus it would be necessary to recognize a considerable number of small genera. Retention of a wide concept for the genus therefore appears to be preferable.

*Schefflera*, by far the largest genus of the family in Malesia, is likewise more broadly conceived than in the past, although in our region only a small number of species from segregate genera are involved (i.e. those formerly in *Brassaia*, *Plerandra*, *Scheffleropsis*, and *Tupidanthus*). On a world-wide basis, FRODIN (1975) recommended the reduction of 12 segregate genera; improved knowledge of the genus required that, as in *Polyscias*, this step be taken or have the genus split into a number of differently organized smaller genera with more serious nomenclatural consequences. A broad concept of *Schefflera* has therefore been adopted. It may be noted here that the flowers in both the former genera *Plerandra* and *Tupidanthus*, characterized by numerous stamens, are thought by FRODIN to represent a secondary development related to bat pollination, and the large fruits for dispersal by bats or larger birds; this is supported by the position of the inflorescences, which are beneath the leafy rosettes as a result of retarded development although the axes remain sympodial and the shoot units mostly orthotropic. As divisions of the larger genus *Schefflera*, they are not at all closely related, conforming to the views of TSENG (1974) on the pollen morphology and contrasting with the views of HARMS (1898) and EYDE & TSENG (1971), who regarded them (as genera) as of close affinity and relatively primitive within the family. In fact, rather different levels of specialization are represented overall by the two taxa, not just in the pollen morphology (TSENG, l.c.).



*Specific delimitation.* This has offered many problems, but fortunately the very abundant material now available from many areas has revealed that many of the species described up to 1951 are in fact conspecific. Especially was the great plasticity in vegetative and inflorescence development not sufficiently appreciated in the past, partly due to imperfect field knowledge of the plants. This has led to considerable reductions in *Arthrophyllum*, *Aralia*, *Osmoxylon*, *Gastonia*, and parts of *Schefflera* and *Polyscias*. Other species have been reduced through a regional approach to the genera. However, in *Osmoxylon* and *Schefflera*, many species from the Philippines, Celebes, western New Guinea, and to a lesser extent Borneo and Sumatra are still known only from very few or even only a single collection; this has meant a rather tentative treatment in many cases. The same applies in a more limited way in some of the other genera. Certain species are rather polymorphic, and at least in *Schefflera* several 'species-complexes' have been discerned.

*References:* BAUMANN-BODENHEIM, Bull. Soc. Bot. Suisse 56 (1946) 13–112; BORCHERT, Amer. J. Bot. 56 (1969) 1033–1041; CORNER, Ways. Trees Malaya (1940) 153; EYDE, Amer. Sci. 63 (1975) 430–437; EYDE & TSENG, Science 166 (1969) 506–508; J. Arn. Arb. 52 (1971) 205–239; FRODIN, The complex of *Cephaloschefflera* in *Schefflera* (*Araliaceae*), Thesis, Cambridge, U.K. (1970); J. Arn. Arb. 56 (1975) 427–448; HALLÉ, OLDEMAN & TOMLINSON, Tropical trees and forests: an architectural analysis, Berlin (1978); HALLIER f. New Phytol. 4 (1905) 151–162; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1898) 1–62; HLADIK, Adansonia 10 (1970) 383–407; HUTCHINSON, Gen. Fl. Pl. 2 (1967) 52–81; PHILIPSON, Bull. Brit. Mus. Nat. Hist. Bot. 1 (1951) 3–20; New Zeal. J. Bot. 5 (1967) 134–165; Blumea 18 (1970a) 490–495; *ibid.* 18 (1970b) 497–505; *ibid.* 21 (1973) 81–89; in Tomlinson & Zimmermann (eds.), Tropical trees as living systems (1978) 269–284; RODRIGUEZ, Univ. Calif. Publ. Bot. 29 (1957) 145–318; in Heywood (ed.), The biology and chemistry of the *Umbelliferae* (1971) 63–91; SEEMANN, Revision of the natural order of *Hederaceae*, repr. from J. Bot. London (1868); VAN STEENIS, Bull. Bot. Gard. Btzg III, 17 (1948) 390–391; THORNE, Aliso 6 (1968) 57–66; Notes R. Bot. Gard. Edinb. 32 (1973) 161–165; TSENG, Amer. J. Bot. 61 (1974) 717–721; VIGUIER, Ann. Sci. Nat. Bot. IX, 4 (1906) 1–209.

*Uses.* A variety of minor local uses are reported by BURKILL (1966), HEYNE (1927), and OCHSE & BAKHUIZEN VAN DEN BRINK (1931) as well as in the notes under individual species in this Flora. The only species that form articles of trade are the taxa of *Polyscias* sect. *Polyscias* popularly grown as foliage and hedge plants; however, many other species in a variety of genera are of actual or potential ornamental worth, with *Schefflera actinophylla* (ENDL.) HARMS and *S. longifolia* (BL.) VIG. being particularly widely used. In Papua New Guinea, *Gastonia spectabilis* is cut for timber and the wood used for light carpentry, boxes, etc.

Monkeys are fond of the flush of some aromatic species of *Schefflera*, as observed in West Java and North Sumatra.

*References:* BURKILL, Dict. rev. ed. (1966); HEYNE, Nutt. Pl. (1927); OCHSE & BAKHUIZEN VAN DEN BRINK, Veget. D.E.I. (1931).

*Notes.* *Nomina nuda* and invalidly published names have only been quoted if they have been cited in Index Kewensis.

*Notes for collectors.* Many araliads present problems to collectors because of the size of their leaves and inflorescences. It is often advisable to select leaves of medium size, but the maximum size of leaves should be recorded on the label. It is important to preserve the junction of leaf and stem and also sufficient of the leaf to allow reconstruction of the whole. Likewise, with inflorescences the base, main axis and some primary branches should be preserved so that the whole can be visualized — ultimate branches alone are insufficient. Fruiting material is as useful as a flowering specimen. Collectors should be alert to note the existence of vegetative heteroblasty and floral dimorphism and document these with specimens and notes; the form in immature plants is important. Rapid drying is essential or all parts will disarticulate and very fragmentary specimens result.

#### KEY TO THE GENERA

1. Petals imbricate. Tribe ARALIEAE.
2. Leaves simple, palmately or pinnately lobed, or entire.
3. Leaves palmately lobed, tomentose . . . . . 1. *Harmsiopanax*
3. Leaves pinnately lobed or entire, glabrous . . . . . 2. *Aralidium*

- 2. Leaves pinnately compound (or bi- or tripinnate).
- 4. Leaves twice (or more) pinnate . . . . . 3. *Aralia*
- 4. Leaves once pinnate.
- 5. Leaflets many . . . . . 4. *Delarbrea*
- 5. Leaflets 5 or fewer . . . . . 5. *Pentapanax*
- 1. Petals valvate.
- 6. Petals with a narrow base, or claw. Tribe MACKINLAYEAE . . . . . 6. *Mackinlaya*
- 6. Petals with a broad base. Tribe SCHEFFLEREAE.
- 7. Inflorescence rays trifid: central branch shorter with 'false fruits', the two lateral longer with normal flowers . . . . . 7. *Osmoxylon*
- 7. Inflorescence branches not as above.
- 8. Ovary with one cell . . . . . 8. *Arthrophyllum*
- 8. Ovary with more than one cell.
- 9. Leaves pinnate.
- 10. Pedicel not articulated below the flower. . . . . 9. *Gastonia*
- 10. Pedicel articulated below the flower . . . . . 10. *Polyscias*
- 9. Leaves not pinnate.
- 11. Pedicel articulated below the flower.
- 12. Leaves digitately compound (or rarely unifoliolate) (Malay Peninsula, Sumatra, Java) . . . . . 11. *Macropanax*
- 12. Leaves simple, not articulated with the petiole (West New Guinea) . . . . . 12. *Anakasia*
- 11. Pedicel not articulated below the flower.
- 13. Leaf simple (or unifoliolate) or palmately lobed.
- 14. Leaf palmately lobed.
- 15. Ovary 2-celled . . . . . 13. *Brassaiopsis*
- 15. Ovary 10- or more-celled . . . . . 14. *Trevesia*
- 14. Leaf simple (or unifoliolate).
- 16. Articulation present between petiole and blade . . . . . *Schefflera*
- 16. No articulation between petiole and blade.
- 17. Ovary 2-celled . . . . . 13. *Brassaiopsis*
- 17. Ovary 4- or more-celled . . . . . 15. *Dendropanax*
- 13. Leaf digitately compound.
- 18. Petiolules joined together by a web of tissue. . . . . 14. *Trevesia*
- 18. No such web of tissue present.
- 19. Styles or stigmas 2.
- 20. Style bifid . . . . . 16. *Acanthopanax*
- 20. Styles united into a column . . . . . 13. *Brassaiopsis*
- 19. Styles or stigmas more than 2 . . . . . *Schefflera*

### 1. HARMSIOPANAX

WARB. in E. & P. Nat. Pfl. Fam. Nachtr. 1 (1897) 166; HARMS, Bot. Jahrb. 56 (1921) 413; HUTCH. Gen. Fl. Pl. 2 (1967) 62; PHILIPSON, Blumea 21 (1973) 81. — *Schubertia* BL. Bijdr. (1826) 884, *nom. illeg., non* MIRB. 1812. — *Horsfieldia* BL. ex DC. Prod. 4 (1830) 87, *non* WILLD. 1805; BTH. in B. & H. Gen. Pl. 1 (1865) 937; BOERL. Handl. 1 (1890) 633; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 60. — Fig. 1-3.

Sparingly branched or single-trunked often monocarpic trees, up to 18 m. *Stems* stout, bearing terminal clusters of large, palmately lobed, often peltate, exstipulate leaves. Trunk, petioles, and sometimes the blades spiny. *Flowers* in very large, repeatedly branched, terminal panicles which develop after the leaves have fallen. *Umbellules* arranged racemously on the ultimate branchlets, sessile or peduncled, each consisting of a few to many pedicelled flowers. Pedicels not jointed, subtended by a bract and bearing two subulate bracteoles. Flowers hermaphrodite or with hermaphrodite flowers on terminal and male flowers on basal branches. *Calyx* a





Fig. 1. *Harmsiopanax ingens* PHILIPSON ssp. *ingens*. a. Leaf,  $\times \frac{4}{5}$ , b. part of inflorescence,  $\times \frac{1}{3}$ , c. umbelule,  $\times 4$ , d. developing fruit,  $\times 12$  (a NGF 36901, b-d PHILIPSON 3483).



minute rim. *Petals* 5, free, valvate with a broad base. *Stamens* 5, dorsifixed, versatile, introrse. *Ovary* inferior, narrowly obconic, densely bristly; cells 2; disk conical, deeply cleft between the two subulate styles. *Fruit* consisting of 2 dry mericarps, each 3-ribbed and bearing a persistent slightly hooked style.

Distr. *Malesia*: 3 spp. from Java, the Lesser Sunda Is., Celebes, and New Guinea.

Ecol. Montane and mossy forest and in regrowth on grassy hillsides.

Notes. *Harmsiopanax* is a small structurally isolated genus confined to Malesia. The three species are uniform both in their vegetative and their reproductive features. It has long been recognized that some of the characters of this genus are anomalous within *Araliaceae* and a return to its earlier position within *Umbelliferae* would have something in its favour. The monocarpic habit is unknown elsewhere in *Araliaceae*, but is not uncommon in *Umbelliferae*. The character of the fruit, which splits into two dry mericarps, closely approaches the fruit structure of *Umbelliferae*, and the vascularization of the gynoecium is also characteristic of that family. However, the structure of the leaf-base, the woody habit, and the shape of the petals all incline towards *Araliaceae*.

#### KEY TO THE SPECIES

1. Upper surface of leaves uniformly setulose.
2. Umbellules sessile. . . . . 1. *H. aculeatus*
2. Umbellules peduncled . . . . . 2. *H. harmsii*
1. Upper surface of leaves with many (or rarely few) larger spines among the setulose hairs 3. *H. ingens*

**1. *Harmsiopanax aculeatus* (BL.) WARB. ex BOERL.**  
 Handl. 3 (1900) 88; KOORD. Exk. Fl. Java 2 (1912) 719; Atlas 4 (1916) f. 668 & 669; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1946) fam. 159, p. 19; BACK. & BAKH. f. Fl. Java 2 (1965) 171; STEEN. Mt. Fl. Java (1972) pl. 3-2; PHILIPSON, Blumea 21 (1973) 82. — *Schubertia aculeata* BL. Bijdr. (1826) 885. — *Horsfieldia aculeata* (BL.) DC. Prod. 4 (1830) 87; BENN. Pl. Jav. Rar. (1840) 123, t. 26; K. & V. Bijdr. 7 (1900) 57; BOERL. Handl. 1 (1890) 647. — *Horsfieldia peltata* BTH. in B. & H. Gen. Pl. 1 (1862) 937. — Fig. 2.

Tree up to 4 m, with a slender spiny trunk. Young stems covered more or less densely with woolly hairs, bristles, and spines with bulbous bases, the spines enlarging on older stems. *Leaves* rounded, variable in size, often 60 cm or more in  $\varnothing$ , deeply palmately lobed, usually peltate in mature leaves, sinuses between the lobes broad or narrow, lobes 7-10, usually sharply and irregularly incised and toothed, apex acute, upper surface rather sparsely covered with evenly-spaced, appressed, sometimes branched hairs (denser on the main veins), underside densely clothed with a soft, woolly tomentum, often with some bristles on the main veins; petiole c. 60 cm, 1 cm  $\varnothing$  at base, terete with clasping base, densely covered with woolley hairs, bristles, and some spines. *Inflorescence* up to c. 70 cm long, main branches rather sparsely covered with a short tomentum and, when young, bearing numerous bracts similar to the leaves but smaller, not peltate, and often 3-lobed or entire; ultimate branchlets slender and often woolly-tomentose, bearing minute linear bracts which subtend the sessile umbellules. Umbellules

about 4 mm  $\varnothing$  in flower, the broadly ovate outer bracts forming a more or less distinct involucre. *Flowers* hermaphrodite or male, either mixed in an inflorescence, or separate, c. 10-15 per umbellule, each subtended by a lanceolate receptacular bract c. 2 mm long. Pedicel c.  $1\frac{1}{2}$  mm long. Calyx rim fringed. Petals strap-shaped, c.  $1\frac{1}{2}$  mm long at anthesis. Filaments c. 2 mm; anthers c. 0.3 mm long, orbicular. Ovary covered with cilia which lengthen as the fruit ripens. *Mericarps* long-ciliate, crowned with the divergent styles.

Distr. *Malesia*: Java, Lesser Sunda Is. (Bali, Lombok, Sumbawa, Flores, Timor), southern half of Celebes. There is a single KORTHALS sheet in L, ticketed from Central Sumatra, but this is presumably wrongly localized.

Ecol. Usually in rather dry, open localities, but also in forest, in secondary forest, also pioneering on rocks, in grasslands and on lava-streams, 300-1800 m. *Fl. fr.* April-Nov. SCHMUTZ found it in Flores flowering in October, but leaves had fallen.

Vern. Java: *djankurang*, *d. tjutjuk*, *djoglorangrang*, *S. gabus*, *garang*, *g. lanang*, *gungrang*, *udulan laki*, J.

Note. In this species lateral shoots usually appear below the infructescences so that the trees are not normally monocarpic.

**2. *Harmsiopanax harmsii* K. SCH. in K. Sch. & Laut. Nachtr. (1905) 329; HARMS, Bot. Jahrb. 56 (1921) 413.**

Tree up to 7 m, with a slender trunk. Young stem covered with bristles, hairs, and spines, older stems with smooth bark with small rounded lenticels and numerous spines. Monocarpic. *Leaves*



Fig. 2. Habit of *Harmsiopanax aculeatus* (BL.) WARB. ex BOERL. Coarse shrub on old lava-streams in E. Java (Mt Idjen) at c. 900 m altitude (Photogr. VAN STEENIS).

rounded, up to 30 by 40 cm, deeply palmately lobed, cordate at base, lobes 5-9 with broad sinuses between them, margin unevenly and sharply dentate, apex acute, upper surface densely covered with evenly spaced bristles of varying size (larger on the main veins), appressed and directed towards the leaf margin, often with woolly hairs inserted on their enlarged bases, the underside very densely woolly and with many bristles, usually bearing crisped hairs on their enlarged bases; petiole

50 cm,  $\frac{1}{2}$  cm  $\varnothing$  at base, terete with clasping base, densely covered with bristles, woolly hairs, and spines. *Panicle* at first with numerous leaf-like bracts, the principal branches with some spines, rather sparsely covered with bristles and hairs, ultimate branches slender and tomentose, bearing linear bracts c. 4 mm long subtending peduncled umbellules; peduncles up to 5 mm, slender, tomentose, bearing 2 minute bracts. Umbellules spherical, c. 4-5 mm  $\varnothing$  in flower, outer bracts not form-



ing a distinct involucre. *Flowers* hermaphrodite, maturing in basipetal succession, the lower bracts of a branch either with sterile umbellules or lacking flowers; up to 60 in an umbellule, each subtended by a lanceolate ciliolate bract *c.* 1 mm long, and borne on a glabrous pedicel *c.* 1¼ mm long. Calyx rim fringed with many lacerate filaments. Petals ovate, *c.* 1 mm long. Filaments *c.* 1 mm; anthers *c.* ½ mm long. Ovary covered with cilia which lengthen as the fruit ripens. *Mericarps* with rounded ribs, long-ciliate, crowned by the divergent styles.

Distr. *Malesia*: Papua New Guinea (Madang Distr., Western Highlands, Morobe Distr. & Central Distr.).

Ecol. Forested hills, grassy slopes, and roadsides, 100–1800 m.

Vern. *Opme*, Ganja, Mt Hagen, *mafiong*, Sattelberg, Morobe Distr.

Note. Information about the habit is inadequate. The stalked spherical umbellules are very distinctive.

3. *Harmsiopanax ingens* PHILIPSON, *Blumea* 21 (1973) 84.

*ssp. ingens.* — Fig. 1, 3.

Unbranched tree up to 18 m with a thick or sometimes slender trunk densely covered, except towards the base of mature specimens, with long, sharp, upwardly directed spines and marked with leaf-scars. Monocarpic. *Leaves* usually peltate, rounded, up to 1 m Ø, deeply palmately lobed, lobes usually with minor lobes and coarsely dentate, apex acute, upper surface bearing few to many long spines, especially on the midrib and principal veins between which the surface is often rugose and glabrous except for the remains of a tomentum of branched hairs, or with many bristles often with woolly hairs on their bases, the under-surface also with few to many long spines and usually clothed with a fawn or greyish woolly tomentum of branched hairs, or densely furnished with bristles usually with woolly hairs on their bases, or occasionally glabrous between the spines



Fig. 3. *Harmsiopanax ingens* PHILIPSON. Left: apex of leafy stem; right: the large inflorescence (Photogr. FRODIN, Murmur Pass, 1971).



except for a few bristles; petiole up to 1 m and 3 cm  $\varnothing$ , terete with clasping base, covered with woolly hairs and bearing many spines. *Panicle* up to 5 m long and 5 m wide, leafless or with lobed bracts c. 10–20 cm long, principal branches spiny especially below, ultimate branches slender, tomentose, bearing linear bracts c. 1 cm long subtending peduncled or sessile umbellules; peduncles elongating as the fruit ripens, up to 4 mm, rather stout, tomentose, bearing 1 or 2 minute bracts. Umbellules bowl-shaped, c. 6–10 mm  $\varnothing$  in flower, enlarging slightly in fruit, with an involucre of about 8 ovate bracts, 2–4 mm long and ciliate distally. *Flowers* hermaphrodite, maturing in basipetal succession, terminal branches bearing maturing fruit while lower branches bear flowers or unopened buds; usually c. 12–16 (8–20) in an umbellule each subtended by an involucre bract or a narrower receptacular bract and borne on a glabrous pedicel 1–2 mm long. Calyx rim fringed with many lacerate filaments. Petals ovate, 1–2 mm long. Filaments 2–3½ mm; anthers 1½–¾ mm long. Ovary covered with cilia which lengthen as the fruit ripens. *Mericarps* with rounded ribs, long-ciliate, crowned by the divergent styles.

Distr. *Malesia*: New Guinea (NW. Irian and extending along the central mountains from the Orion Mts to the Owen Stanley Range, Murray Pass).

Ecol. Montane and mossy forest and second-growth forest, 2000–3600 m, occasionally rather lower.

Vern. Papua: *mauku*, Huli; Mandated Terr.: Sepik Distr., *kamul*, Hindenburg Ra.; Western Highlands: *murri*, Hagen, *tolsan*, Minj, *mauri*, Melpa, *mai*, Mendi, *kinogore*, *makua*, *makw*, Enga; Eastern Highlands: *kimu*, Ka, *ollu*, Chimbu.

Notes. A striking, single-trunked, monocarpic tree bearing immense inflorescences. The bark is described as grey brown and the wood white with a wide pith. The inflorescence has the appearance of bearing female flowers above and male flowers below, but this is evidently due to a basipetal sequence of anthesis. The terminal flowers have

stamens when freshly opened and all those on lower branches bear styles. Apparently, the female organs of the lower branches are functional because branches from mature inflorescences bear fruit uniformly. Nevertheless, herbarium specimens cannot adequately represent such a large inflorescence so that the possibility remains that some female-sterile flowers occur in this species.

Variation occurs in both tomentum and inflorescence characters. For example, most specimens from West Irian have small umbellules and fewer leaf-spines. In the eastern part of the Eastern Highlands District a number of gatherings display a series of variations: the under-leaves give the appearance of being glabrous between bristles, the inflorescence branches bear small leafy bracts, the umbellules are sessile, with rather numerous (c. 18–21) small flowers subtended by rather broad bracts. Specimens from Mt Otto show all these features combined, but other specimens from this region diverge from the typical state in only some of these characters. No specimens of this subspecies are known from the Finisterre Range and only one from the Owen Stanley Range.

*ssp. moniliformis* PHILIPSON, *Blumea* 21 (1973) 86.

Umbellules disposed irregularly along the branches, singly or in small groups, with bare spaces intervening, sessile; flowers usually c. 20–30 per umbellule, floral parts smaller than in *ssp. ingens*; fruiting heads rather small (c. 5 mm  $\varnothing$ ).

Distr. *Malesia*: Papua New Guinea (districts bordering on the Huon Gulf).

Vern. Morobe Distr.: *mobian*, Finschhafen.

Note. This subspecies occurs at lower altitudes than is usual for *ssp. ingens* (1500–2000 m). No specimens of either subspecies have been collected from higher altitudes in the mountains north of the Markham River and the Huon Gulf. At higher altitudes in the Owen Stanley Range *ssp. ingens* is known from one gathering. The most south-easterly gathering at present known (CARR 13603) has a distinctive appearance due to the straight rigid inflorescence branches with small sessile umbellules.

## 2. ARALIDIUM

MIQ. Pl. Jungh. 3 (1855) 423; Fl. Ind. Bat. 1, 1 (1856) 762, t. 13; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 25; BTH. in B. & H. Gen. Pl. 1 (1865) 936; HEMSL. in Hook. Ic. Pl. 16 (1886) t. 1549; BOERL. Handl. 1 (1890) 631; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 60; HUTCH. Gen. Fl. Pl. 2 (1967) 59. — **Fig. 4.**

Unarmed tree or shrub with simple, exstipulate pinnately lobed, irregularly incised, or entire leaves. *Inflorescence* a large panicle, with cymules of small flowers arranged racemously on the branches. Pedicels articulated below the ovary. Dioecious. *Male flowers*: calyx 5; petals 5, imbricate; stamens 5, anthers dorsifixed. *Female flowers*: calyx and corolla similar to male; staminodes 5; ovary with 3



Fig. 4. *Aralidium pinnatifidum* (JUNGH. & DE VRIESE) MIQ. a. Habit,  $\times 2/5$ , b.  $\sigma$  flower and bud, c.  $\varphi$  flower and bud, both  $\times 8$ , d. fruit, seed, and CS, slightly enlarged (a VAN BALGOOY 2185, b COCKBURN FRI 8376, c SINCLAIR 9884, d fresh material). Drawn by W. R. PHILIPSON.



locules (2 abortive) and 1 ovule, styles 3–4, tapering from broad bases, stigmas terminal. *Fruit* drupe-like. *Seed* solitary, pendulous from a thickened funicle, 4–5-grooved; endosperm deeply ruminant.

Distr. Monotypic. Peninsular Thailand and *Malesia*: Malay Peninsula, Sumatra, and Borneo.

The record from Java by MIQUEL (Ann. Mus. Bot. Lugd.-Bat. 1, 1863, 25) is erroneous (see K. & V. Bijdr. 7, 1900, 2).

Ecol. Primary and secondary forest, from sea-level to c. 1250 m.

Notes. The single species forms a genus with several unique features, namely the large, simple, characteristically pinnately lobed leaves, the absence of resin ducts, the diffuse panicles of male or female flowers, the 3-carpellate ovary with a single surviving loculus resulting in a single-seeded fruit, the dorsal raphe, the deeply ruminant endosperm, and the enlarged funicle.

The genus is treated here as a member of the *Araliaceae* mainly as a matter of convenience. Sometimes it has been placed in the *Cornaceae* (e.g. RIDL. Fl. Mal. Pen. 1, 1922, 894, and VIGUIER, Ann. Sc. Nat. Bot. 4, 1906, 171), and on full investigation it may well prove to be better placed in that family. The absence of resin ducts and the dorsal raphe strongly support a relationship with the *Cornaceae* and its immediate allies, though the absence of borders to the pits of the xylary fibres is characteristic of *Araliaceae*.

Several genera formerly placed in the *Cornaceae* have now been elevated to the rank of family. If this course is followed then *Aralidium* should also be segregated. Many of the features of *Aralidium* approach those of *Griselinia* (segregated as *Griselinaceae*) and possibly these two genera should be united as a single family.

**1. *Aralidium pinnatifidum*** (JUNGH. & DE VRIESE) MIQ. Fl. Ind. Bat. 1, 1 (1856) 763; HEMSLEY in Hook. Ic. Pl. 16 (1886) t. 1549; BOERLE in Handl. 1 (1890) 631; RIDL. Fl. Mal. Pen. 1 (1922) 895; PHILIPSON, J. Bot. 78 (1940) 118. — *Aralia pinnatifida* JUNGH. & DE VRIESE, Ned. Kruidk. Arch. 1 (1846) 15; Ann. Sc. Nat. III, 6 (1846) 115. — *A. dentatum* MIQ. Sum. (1861) 340. — *A. integrifolium* HEINE in Fedde, Rep. 54 (1951) 245. — Fig. 4.

Shrub or small tree up to c. 10 m, rarely reaching 20 m and 25 cm  $\varnothing$ , glabrous in its vegetative parts; buds enclosed in long sheathing leaf-bases. *Leaves* spaced with distinct internodes, usually c. 30 by 22 cm or more,  $\pm$  regularly pinnately incised, frequently as deep as the midrib, lobes oblong-acuminate and decurrent on the midrib, c. 2 $\frac{1}{2}$  cm wide or more, the lobing sometimes irregular, and occasionally the blade entire and broadly ovate (up to 25 by 20 cm) or rarely lanceolate, leaf margin either entire or coarsely dentate, especially on the terminal lobe; petioles 5–12 cm, broadly channelled above, clasping the stem with a slightly dilated base, exstipulate. *Panicles* terminal, or occasionally in the upper axils, to 50 cm long, pendulous, puberulous; main bracts caducous, but the minute bracteoles often persisting until anthesis. *Flowers* numerous, small (buds c. 2 $\frac{1}{2}$  mm long), fragrant, creamy or red-tinged, ovary, calyx lobes and petals densely covered in a minute but coarse puberulence. *Male flowers* with the corolla persistent during anthesis, petals c. 1 $\frac{1}{2}$  mm long, strap-shaped, spreading, stamens c. 1 mm with flattened filaments and round anthers; stylopodium a succulent disk with a concave centre; styles absent, the ovary 1 $\frac{1}{2}$  mm long, narrowly turbinate,

without a loculus. *Female flowers* with the corolla caducous at anthesis together with the staminodes, styles divergent from their gibbous bases, ovary ovate with a single loculus (two abort early); ovule pendulous. *Fruit* usually obliquely ellipsoid, tapering to the apex and c. 3–4 $\frac{1}{2}$  cm long, but rarely subspherical, white when immature, ripening to purplish or black, juicy; exocarp fleshy, endocarp chartaceous. *Seed* broadly ellipsoid, 2–2 $\frac{1}{2}$  cm long, with the surface patterned with deep ruminations.

Distr. Peninsular Thailand; in *Malesia*: Malay Peninsula (from Kedah southwards common; Singapore), throughout Sumatra (also in Simalur I.), Anambas Is. (Siantan) and throughout Borneo.

Ecol. Frequent in evergreen primary rain-forest, also in open bamboo forest and secondary growths, from sea-level to c. 1250 m, in Borneo up to 1500–1800 m. *Fl. fr.* Jan.–Dec.

Uses. The only use, once mentioned, is from Brunei, as “leaves make good ghost medicine”.

Vern. Malay Peninsula: *lèmpèdu buaya*, (*poko*) *balai*, *pungar*, *sahalat*, *sèbalai tingal*, *sibilai*, *tèbalai*, M; Sumatra: (*kayu*) *attarodan*, Asahan, Batak lang., *sègèntu*, Gajo, *mèdung*, M, *manèl silai*, *mannel dotan*, *sukun dotan*, M, Simalur; Anambas Is.: *ballok*, M, Siantan; Borneo: *daun tutchol antu*, Brunei, Iban lang.

Note. Entire leaves are not infrequent throughout the range of the species, so that the recognition of a second species using this character is not justified. Coarsely dentate leaf-margins were also employed as a specific character but are merely a minor variation. Some specimens from Mt Kinabalu have rather small globose fruits, but the typical form of fruit also occurs on that mountain.



## 3. ARALIA

LINNÉ, Gen. Pl. ed. 5 (1754) 134; Sp. Pl. (1753) 273; DC. Prod. 4 (1830) 257; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 6; BTH. in B. & H. Gen. Pl. 1 (1865) 936; BOERL. Handl. 1 (1890) 629; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 56; STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 391; HUTCH. Gen. Fl. Pl. 2 (1967) 63; STONE, Gard. Bull. Sing. 30 (1977) 134; PHILIPSON, l.c. 97. — *Acanthophora* MERR. Philip. J. Sc. 13 (1918) Bot. 316, *non* LAMOUREUX, 1813 (*Algae*); STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 390. — **Fig. 5, 6.**

Sparingly branched shrubs or small trees, or climbing, rarely (*extra-Mal.*) herbaceous, glabrous or hairy, often prickly. *Leaves* pinnate to tripinnate, usually with leaflets at the insertion of the lateral pinnae; leaflets serrate; petiole with a sheathing base. *Inflorescence* a terminal panicle; flowers sessile or pedicelled, with an articulation below the flower; calyx with 5–6 teeth; petals 5–6, imbricate; ovary 2–6-celled; styles 2–6 free or shortly connate below. *Fruit* a fleshy drupe; pyrenes cartilaginous, compressed; endosperm uniform.

Distr. More than 30 *spp.* in North America (S. to Mexico) and East Asia, 6 *spp.* in *Malesia*: Sumatra, Malay Peninsula, Java, Lesser Sunda Is. (Sumba), Borneo, Celebes, Philippines, and West New Guinea.

Ecol. Usually on scrubby hillsides and in secondary growth, often in ravines or near streams, or in thickets near or above the limit of tree-growth, at low altitude (100 m), but usually in the montane zone, up to 3000 m.

Note. For a discussion of specific distinctions see VAN STEENIS, l.c. 391. HUI-LIN LI in Sargentia 2 (1942) 101, treated some species that extend into Malesia. MERRILL considered that the climbing habit and recurved spines of *Acanthophora* justified its separation as a distinct genus, but more recent authors have not agreed.

## KEY TO THE SPECIES

1. Flowers sessile (capitate) or very shortly pedicelled.
2. Flowers sessile, underside of leaf  $\pm$  densely tomentose, hairs of the branches and inflorescence  $\pm$  appressed and felted, bracts around the capitula enveloped in hairs . . . . . 1. *A. dasyphylla*
2. Flowers short-pedicelled, underside of leaf sparsely tomentose, hairs of the branches and inflorescence  $\pm$  patent, bracts around the capitula less densely tomentose . . . . . 2. *A. javanica*
1. Flowers  $\frac{1}{2}$ – $1\frac{1}{2}$  cm pedicelled (umbellate).
3. Climbing or scrambling liana, spines curved . . . . . 3. *A. scandens*
3. Erect shrubs or small trees, spines straight.
4. Leaflets glaucous beneath, margins with few crenations. Fruit small (c. 3 mm long) . . . . . 4. *A. bipinnata*
4. Leaflets green (or with fawn pubescence) beneath, margins serrate. Fruit rather larger (4–6 mm long).
5. Young parts and undersurface of leaves glabrous (but with small spines) . . . . . 5. *A. ferox*
5. Young parts and undersurface of leaves pubescent . . . . . 6. *A. montana*

1. *Aralia dasyphylla* MIQ. Fl. Ind. Bat. 1, 1 (1856) 751; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 9, *incl. var. strigosa* MIQ. *et var. latifolia* MIQ.; BOERL. Handl. 1 (1890) 646; K. & V. Bijdr. 7 (1900) 53; KOORD. Exk. Fl. Java 2 (1912) 718; Atlas 4 (1916) f. 673 A–K; HUI-LIN LI, Sargentia 2 (1942) 20; BAKH. f. Blumea 6 (1947) 367, *incl. var. urticifolia* (BL. *ex* MIQ.) BAKH. f.; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159,

p. 18; STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 391; NGOC-SANH BUI, Adansonia 4 (1964) 464; BACK. & BAKH. f. Fl. Java 2 (1965) 170; STEEN. Mt. Fl. Java (1972) pl. 3–1; PHILIPSON, Gard. Bull. Sing. 30 (1977) 98; Y.-R. LING, Acta Phytotax. Sin. 15 (1977) 86. — *A. chinensis* (non L.) BL. Bijdr. (1826) 870. — *A. urticifolia* BL. *ex* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 9; BOERL. Handl. 1 (1890) 646; K. & V. Bijdr. 7 (1900) 55; KOORD. Atlas 4

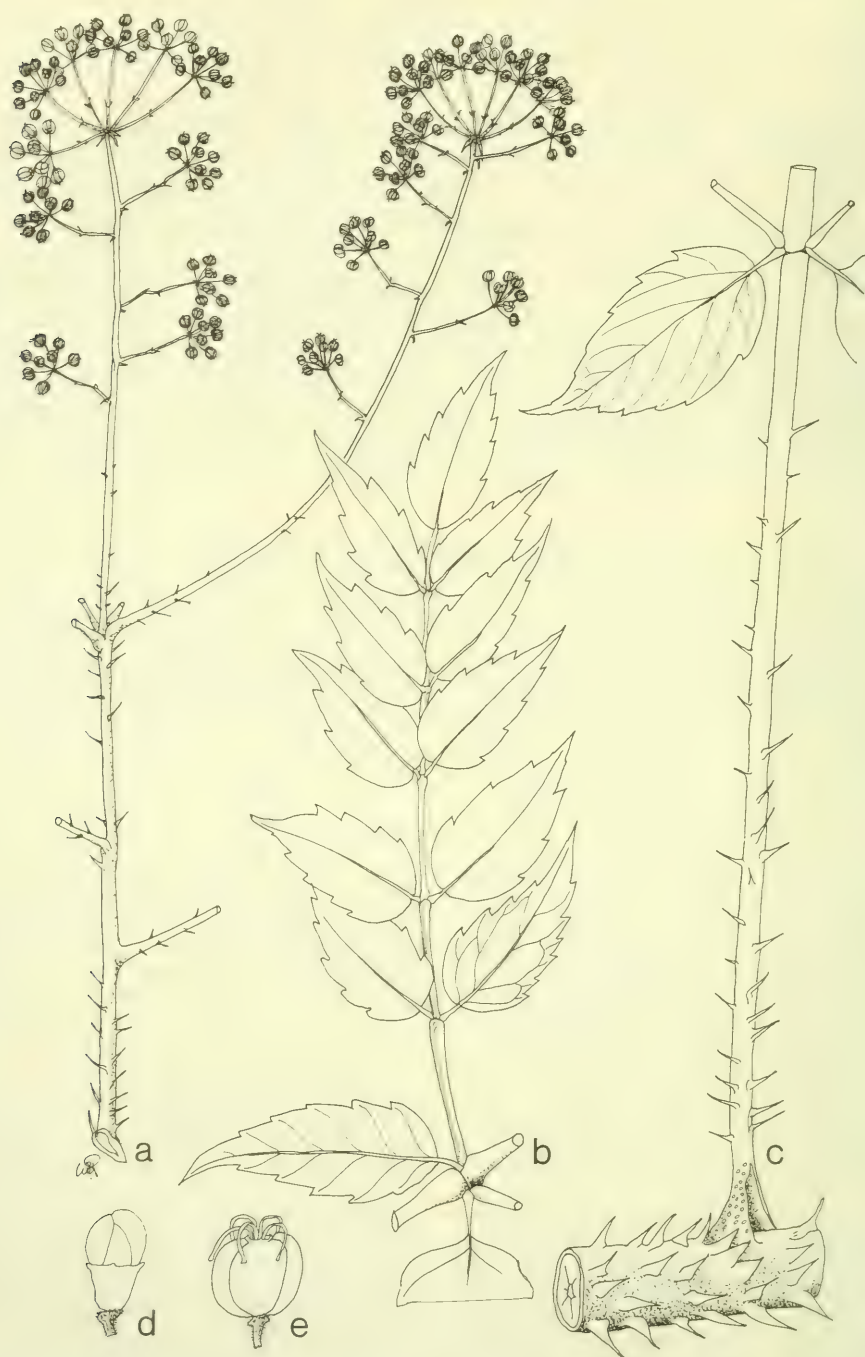


Fig. 5. *Aralia bipinnata* BLANCO. *a.* Upper branches of inflorescence, *b.* pinna, *c.* base of petiole, all  $\times \frac{2}{5}$ , *d.* flower bud, *e.* fruit, both  $\times 3$  (JACOBS 7017). Drawn by W. R. PHILIPSON.



(1916) f. 673 L-N. — *A. beccarii* RIDL. J. Mal. Br. R. As. Soc. 1 (1923) 64. — Fig. 6.

Prickly shrub or small tree, often unbranched, to c. 5 m; young parts densely brown pubescent. *Leaves* forming large rosettes at the summit of the stems, c. 1 m long (or more), bi- or tripinnate, with a pair of leaflets (occasionally pinnate) at each division of the rachis, the petiole, rachis and lateral rachides prickly or unarmed, densely pubescent; leaflets subsessile or petiolule c. 5 mm long (or longer), usually densely pubescent on the lower surface, less dense above, ovate to oblong-ovate, c. 5–14(–18) by 3–5(–10) cm, base rounded to subcordate, apex acuminate, margin finely or sometimes coarsely serrulate; petiole c. 40 cm, with an elongated sheathing base and a small ligule. *Inflorescence* a large terminal panicle, 70 cm or more long, densely brown pubescent, rachis bearing several secondary branches c. 30–40 cm long, with ultimate branches arranged racemously, bracts ligulate, ending in heads of several sessile flowers, surrounded by an involucre of small usually densely pubescent bracts. *Calyx* with 5 usually obtuse teeth; petals 5, c. 1½ mm long, glabrous; stamens 5; ovary c. 2 mm long, glabrous, 5-celled; styles 5, slightly connate below. *Fruit* globose, c. 3½ mm Ø, ribbed when dry.

Distr. Northwards to southern China; in *Malesia*: Sumatra, Malay Peninsula, West and Central Java.

Ecol. Primary forest and secondary growths in deep ravines or open hillsides, from low altitude (c. 100 m) to 2500 m.

Vern. Sumatra: *kaju burle lasët*, *k. sèpak-sipang*, *k. si marsuga-suga*, *k. sipang-sipang*, *sami-mpadan*, M; Java: *gorang*, *osangsing*, J, *pangang tjutjuk*, S.

Note. The capitulate flowers are characteristic (see also under *A. javanica*). The presence of this species in the Malay Peninsula has often been overlooked, though it extends into southern China. Its variability was discussed by VAN STEENIS (1948, l.c.).

2. *Aralia javanica* MIQ. Pl. Jungh. 3 (1855) 420; Fl. Ind. Bat. 1, 1 (1856) 749; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 9; BOERL. Handl. 1 (1890) 646; K. & V. Bijdr. 7 (1900) 55; KOORD. Exk. Fl. Java 2 (1912) 718; Atlas 4 (1916) f. 670; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 17; BACK. & BAKH. f. Fl. Java 2 (1965) 170; PHILIPSON, Gard. Bull. Sing. 30 (1977) 98.

A shrub or small tree, often unbranched, young parts covered with brown pubescence which persists on the stems and rachides of the inflorescence as ± patent hairs. *Leaves* tufted at the ends of the branches, bipinnate with a pair of leaflets at the divisions of the rachis; leaflets variable in size, subsessile or the petiolules up to c. 2 cm, blade ovate to elliptic, up to 18 by 8 cm (usually smaller),

both surfaces with sparse, short, appressed, bristly hairs, base cuneate to truncate, apex acuminate, margin finely and unevenly serrulate; petiole 20–30 cm. *Inflorescence* a large terminal panicle, rachis bearing several secondary branches c. 30–40 cm long, with the ultimate branches bearing heads (or subumbellules) of c. 10 flowers, surrounded by an involucre of small linear bracts. *Calyx* with 5 small teeth; petals 5; stamens 5; ovary c. 2 mm long, glabrous, 5-celled; styles erect at anthesis. *Fruit* ovoid, c. 5 mm long, ribbed when dry, with the persistent styles recurved.

Distr. *Malesia*: West and Central Java (Mts Papandayan, Malabar, Diëng, Surakarta).

Ecol. Mountain forests, 2000–3000 m.

Note. This imperfectly known species may prove to be a form of the widespread *A. dasyphylla*, from which it appears to differ in the shortly pedicelled flowers, the sparser leaf-tomentum, the more patent hairs on the inflorescence branches and the bracts of the umbellules less thickly enveloped in hairs.

3. *Aralia scandens* (MERR.) HA, Nov. Sist. Vyssh. Rast. 11 (1974) 229; STONE, Gard. Bull. Sing. 30 (1977) 276, f. 1; PHILIPSON, l.c. 99. — *Acanthophora scandens* MERR. Philip. J. Sc. 13 (1918) Bot. 316; En. Philip. 3 (1923) 236; STEEN. Bull. Bot. Gard. Btzig III, 17 (1948) 390. — *A. ferox* (MIQ.) KING, J. As. Soc. Beng. 67, ii (1898) 45; KOORD. Minah. (1898) 498; MERR. En. Born. (1921) 458; RIDL. Fl. Mal. Pen. 1 (1922) 872; MASAM. En. Phan. Born. (1942) 564.

Prickly scandent shrub, glabrous, reaching a height of 10 m or more, stems c. 2½ cm Ø. *Leaves* dispersed (c. 30 cm apart), up to 1½ m long, tri- or quadripinnate with a pair of leaflets at each division of the rachis, prickly on the petiole, rachides, and sometimes on the leaf veins; leaflets ovate to elliptic-ovate or ovate-lanceolate, petiolules 3–10 mm, blade 5–14 by 2½–5 cm, base rounded or subcordate, apex acuminate, margins finely spinulose-denticulate; petiole to 35 cm, with an elongated sheathing base and a small ligule. *Inflorescence* a large terminal spiny panicle, the main rachis to c. 60 cm, bearing secondary branches singly or in whorls, up to 50 cm; ultimate branches 1–4 cm, subtended by lanceolate bracts, racemously arranged, ending in umbellules; umbellules c. 10–20-flowered, pedicels slender, 10–12 mm, with lanceolate bracts 2–3 mm long, articulated below the flower. *Calyx* with 5–6 short acute teeth; petals 5–6, with a broad base, imbricate; stamens 5–6, filaments c. 4 mm long, anthers c. 1 mm long; ovary turbinate c. 2½ mm long, 5–6-celled, styles 5–6, free or only slightly connate below, at first erect. *Fruit* ellipsoidal, c. 5 mm long, purple to blue-black, deeply furrowed when dry, crowned by the persistent radiating styles.

Distr. *Malesia*: Malay Peninsula (Perak, Selangor, Pahang), Sabah (Mt Kinabalu), Philippines





Fig. 6. *Aralia dasyphylla* MiQ. Habit, Tjibodas, on slope of Mt Gedeh, W. Java, c. 1400 m altitude (Photogr. PHILIPSON, 1973).

(Luzon, Panay, Catanduanes, Mindanao), Celebes (Menado, Buton I., S. Celebes).

Ecol. Thickets on slopes and mountainsides, often near streams, or among secondary growths, 180–1550 m.

Uses. In Mindanao is reported that scrapings of the bark are applied to wounds and a decoction of the boiled bark is drunk to relieve internal pain.

Vern. Philippines: *cwangayan*, Mindanao, *simbar*, Bag.

Note. The only species with the habit of a liana, with spaced leaves, and recurved spines. The flowers are whitish or yellowish, and slightly fragrant and are visited by numerous small bees. The fruit is purple and fleshy.

4. *Aralia bipinnata* BLANCO, Fl. Filip. (1837) 222; MERR. Sp. Blanc. (1918) 294; En. Philip. 3 (1923) 235; STEEN. Bull. Bot. Gard. Btztg III, 17 (1948) 392, *incl. f. inermis* STEEN.; PHILIPSON, Gard. Bull. Sing. 30 (1977) 99. — *A. hypoleuca* PRESL, Epim. (1851) 250; MIQ. Fl. Ind. Bat. 1, 1 (1856) 751; F.-VILL. Nov. App. (1880) 101; VIDAL, Phan. Cuming. Philip. (1885) 117; Rev. Pl. Vasc. Filip. (1886) 144; HARMS, Bot. Jahrb. 23 (1896) 18; MERR. Philip. J. Sc. 5 (1910) Bot. 369; En. Philip. 3 (1923) 235. — *A. javanica* (non MIQ.) F.-VILL. Nov. App. (1880) 101. — *A. glauca* MERR. Philip. J. Sc. 2 (1907) Bot. 291; En. Philip. 3 (1923) 236. — *A. apoensis* ELMER, Leaflet. Philip. Bot. 7 (1914) 2325; MERR. En. Philip. 3 (1923) 235. — Fig. 5.

A shrub or small, sparsely branched tree to 7 m, with prickly stems. *Leaves* to 1½ m or more long, forming large crowns at the ends of the branches, bipinnate, with a pair of pinnae at each division of the rachis, with some prickles, especially on the petiole or unarmed, the rachis swollen and articulated at the nodes; leaflets sessile or with a short petiolule, ovate to lanceolate, usually 4–5 by 2–2½ cm, but variable in size, apex acute or acuminate, base rounded to cordate, usually markedly oblique in lateral leaflets, margin conspicuously crenate, upper surface green, glabrous, lower surface glaucous, pubescent along the veins and sometimes sparingly on the mesophyll, sometimes only in the angles of the lower veins, or almost glabrous throughout, primary and secondary veins conspicuous; petiole to 30 cm, base long sheathing and slightly ligulate. *Inflorescence* a large terminal panicle 30–70 cm long (or more), peduncle and also usually the main branches prickly, the whole either almost glabrous or pubescent; peduncle 5–18 cm long, stout; main rays c. 5–10, mostly clustered at the apex of the rachis, 25–65 cm long, bearing many short tertiary branches along their length; tertiary branches usually 5–10 cm long, ending in umbellules, and bearing a small number of lateral umbellules, or branches, minute lanceolate bracts subtending the branches of the third or higher orders; umbellules with c. 20–30 radiating

pedicels; pedicels 5–10 mm. *Calyx* lobes 5, rounded, ½ mm long; petals 5, 1½ mm long; stamens 5; ovary 5-celled, styles subulate, free. *Fruit* spheroidal, c. 3 by 4 mm, strongly 5-ribbed when dry, persistent styles spreading.

Distr. Taiwan; in *Malesia*: Philippines (Luzon, Leyte, Negros, Mindoro, Mindanao) and West New Guinea (Vogelkop Peninsula, possibly also in Swart Valley).

Ecol. In rather open forests, ravines, and in thickets and secondary growths, (700–)1000–2450 m.

Vern. Philippines: *badbaranai*, C.Bis., *dasanat*, Neg., *karugi*, Buk., *magkasau*, Bis., *mara-bauya*, Bag., *papang*, Bon., *sugsuga*, Ig.

Note. VAN STEENIS *l.c.* discussed the variability in pubescence and the development of spines.

5. *Aralia ferox* MIQ. Fl. Ind. Bat. 1, 1 (1856) 750; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 9; BOERL. Handl. 1 (1890) 629; K. & V. Bijdr. 7 (1900) 49; KOORD. Exk. Fl. Java 2 (1912) 717; Atlas 4 (1916) f. 671; Fl. Tjib. 2 (1923) 229; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 18; STEEN. Bull. Bot. Gard. Btztg III, 17 (1948) 394; BACK. & BAKH. f. Fl. Java 2 (1965) 170; PHILIPSON, Gard. Bull. Sing. 30 (1977) 99. — *A. filicifolia* RIDL. J. Fed. Mal. St. Mus. 8 (1917) 42, non C. MOORE, 1876.

Spiny shrub or small tree, usually unbranched, to c. 10 m. *Leaves* forming a large rosette at the summit of the stem, up to c. 1 m long, or shorter below the inflorescence, bi- or tripinnate, with a pair of leaflets (often pinnate) at each division of the rachis, prickly on the petiole, main rachis, and often on the lateral rachides; leaflets sessile or petiolules to c. 5 mm, ovate or ovate-oblong, usually c. 3 by 1¾ cm, but variable in size, base truncate to rounded or cuneate, apex acute acuminate, margin sharply serrate, both surfaces with small bristle-like spines, especially on the veins, sometimes with small spines on the underside of the midrib; petiole to c. 25 cm, with an elongated sheathing base and a small ligule. *Inflorescence* a large terminal panicle, 25–50 cm long, glabrous, the main rachis rather short, bearing a few lateral or a terminal cluster of branches c. 15–25 cm long; tertiary branches disposed singly or in subverticils, ending in umbellules and bearing a variable number of lateral umbellules. *Flowers* c. 10–12 per umbellule; pedicels c. 5–6 mm, articulated below the ovary; calyx a rim bearing 5 narrow or triangular teeth; petals and stamens 5; ovary turbinate c. 2 mm long; styles 5, erect at first, soon spreading, scarcely united at the base. *Fruit* spheroidal, c. 6 by 5 mm, deeply furrowed when dry, the persistent styles radiating.

Distr. *Malesia*: Central W. Sumatra (Mt Kerintji), W. Java (Mts Gedeh, Patuha and Tangkuban Prah).



Ecol. In montane scrub and among scattered trees, 1900–2900 m.

Vern. *Pabong, pangang njirvan, panggang-tjěrmé, S.*

*forma nana* STEEN. Bull. Bot. Gard. Btżg III, 17 (1948) 394, f. 1.

Smaller, probably  $\frac{1}{2}$ –1 m, leaves tripinnate, 30 cm long, spiny all over; leaflets 4–13 by 2–7 mm, rachides of the ultimate pinnae winged.

Distr. *Malesia*: Central W. Sumatra (Mt Talang).

Ecol. Growing about 2500 m.

Note. VAN STEENIS considered this interesting dwarf form to represent the extreme of a series in size variability.

6. *Aralia montana* BL. Bijdr. (1826) 870; MIQ. Fl. Ind. Bat. 1, 1 (1856) 750; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 9, incl. var. *acutata* MIQ.; BOERL. Handl. 1 (1890) 646; K. & V. Bijdr. 7 (1900) 51; KOORD. Exk. Fl. Java 2 (1912) 718; Atlas 4 (1916) f. 672; STEEN. Bull. Bot. Gard. Btżg III, 17 (1948) 391; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 17; BAKH. f. Blumea 6 (1950) 367, incl. var. *crassifolia* BAKH. f.; BAK. & BAKH. f. Fl. Java 2 (1965) 170; PHILIPSON, Gard. Bull. Sing. 30 (1977) 100. — *A. bipinnata* REINW. ex BL. Cat. (1823) 43, nomen; ex DE VRIESE, Pl. Ind. Bat. Or. (1857) 84, nomen in synon. — *Panax armatus* WALL. [Cat. (1832) n. 4933, nomen] ex G. DON, Gen. Syst. 3 (1834) 386. — *A. decomposita* REINW. ex DE VRIESE, Pl. Ind. Bat. Or. (1857) 84, nom. illeg. altern. — *A. armata* (WALL.) SEEM. J. Bot. 6 (1868) 134; CLARKE, Fl. Br. Ind. 2 (1879) 723; KING, J. As. Soc. Beng. 67, ii (1898) 44; RIDL. Fl. Mal. Pen. 1 (1922) 873; HUI-LIN LI, Sargentia 2 (1942) 106. — *A. thomsonii* SEEM. J. Bot. 6 (1868) 134; CLARKE, Fl. Br. Ind. 2 (1879) 723; KING, J. As. Soc. Beng. 67, ii (1898) 44; RIDL. Fl. Mal. Pen. 1 (1922) 873; HUI-LIN LI, Sargentia 2 (1942) 112.

Shrub or small tree, frequently unbranched, with prickly stems, occasionally attaining a height of 12 m. Leaves to 1 m or more long, forming large crowns at the ends of the branches, bipinnate, with a pair of simple or occasionally pinnate leaflets at each division of the rachis, usually with some prickles, especially on the petiole, or unarmed, the rachis constricted at the joints; leaflets sessile or with a short petiolule, ovate, up to 14 by 7 cm, apex acute to acuminate, base truncate or rounded, oblique in lateral leaflets, margin sharply serrate, upper surface with the remains of a strigose tomentum, often  $\pm$  rugose, lower surface often with a  $\pm$  velvety tomentum, or with more harsh hairs  $\pm$  confined to the veins; petiole to 30 cm, its base sheathing and ligulate. Inflorescence a large terminal panicle, peduncle and branches tomentose, prickles, if any, confined to the peduncle and main

rachis, small usually persistent linear or ovate bracts c.  $1\frac{1}{2}$  cm long subtending the branches and also spaced along the peduncle; bracts of tertiary branches similar but smaller; secondary branches at intervals along the main rachis, c. 35 cm long, bearing numerous tertiary branches along their length; tertiary branches usually c. 6 cm long, ending in umbellules, and often bearing a number of lateral umbellules; umbellules with c. 20–30 radiating pedicels; pedicels usually 12–15 mm, occasionally shorter, pubescent. Flowers hermaphrodite; calyx lobes 5, triangular or rounded; petals 5, c. 2 mm long; stamens 5; ovary 5-celled, glabrous; styles subulate, connate below, free and spreading above. Fruit spheroidal, up to c. 4 by 4 mm, strongly 5-ribbed when dry, surmounted by the reflexed styles.

Distr. *Malesia*: Malay Peninsula, Sumatra, Java, Borneo (Sarawak, Sabah), Celebes, Lesser Sunda Is. (Sumba).

Ecol. Primary and secondary forest, bamboo forest and low-lying moist ground, from near sea-level to 2600 m.

Vern. *Gorang, panggang tjutjuk, S*; Malay Peninsula: *poko dulang-dulang*; Sarawak: *tepa paluk*.

Notes. This species is considered to include all West Malesian examples with pedicelled flowers and pubescent leaves. This broad concept is contrary to former treatments which have recognized several species (*A. thomsonii*, *A. armata*). The alliance with *A. chinensis* L. and *A. decaisneana* HANCE is also very close. The application of names to this and other Javanese species has been very confused. The position is ably discussed by VALETON (in K. & V. Bijdr.) and by VAN STEENIS (*l.c.*). In most specimens the lower leaf surface and the pedicels are densely tomentose, but there are specimens in which the leaf is only sparsely hairy and the pedicels may be glabrous. *A. armata* appears to be within the range of variation of the complex although this plant is very spiny, its leaves and inflorescences always being provided with numerous short spines. The leaflets also are thinner and smoother and, like the pedicels, are less densely pubescent (see NGOC-SANH BUI, Adansonia 9, 1969, 461). However, *A. armata* (if distinct) has been collected only very rarely in the Malay Peninsula and only in the extreme north. The most aberrant specimens are those with glabrous umbellules which are mostly from Sumatra but also from Java: they may indicate that *A. foliolosa* SEEM. should also be included in this complex.

#### Excluded

*Aralia capitulata* JUNGH. & DE VRIESE, Ned. Kruidk. Arch. 1 (1846) 17; Ann. Sc. Nat. III, 7 (1846) 116 is, cf. SLEUMER, Fl. Males. I, 7 (1971) 24 = *Gomphandra capitulata* (JUNGH. & DE VRIESE) BECC. (Icacinaeae).



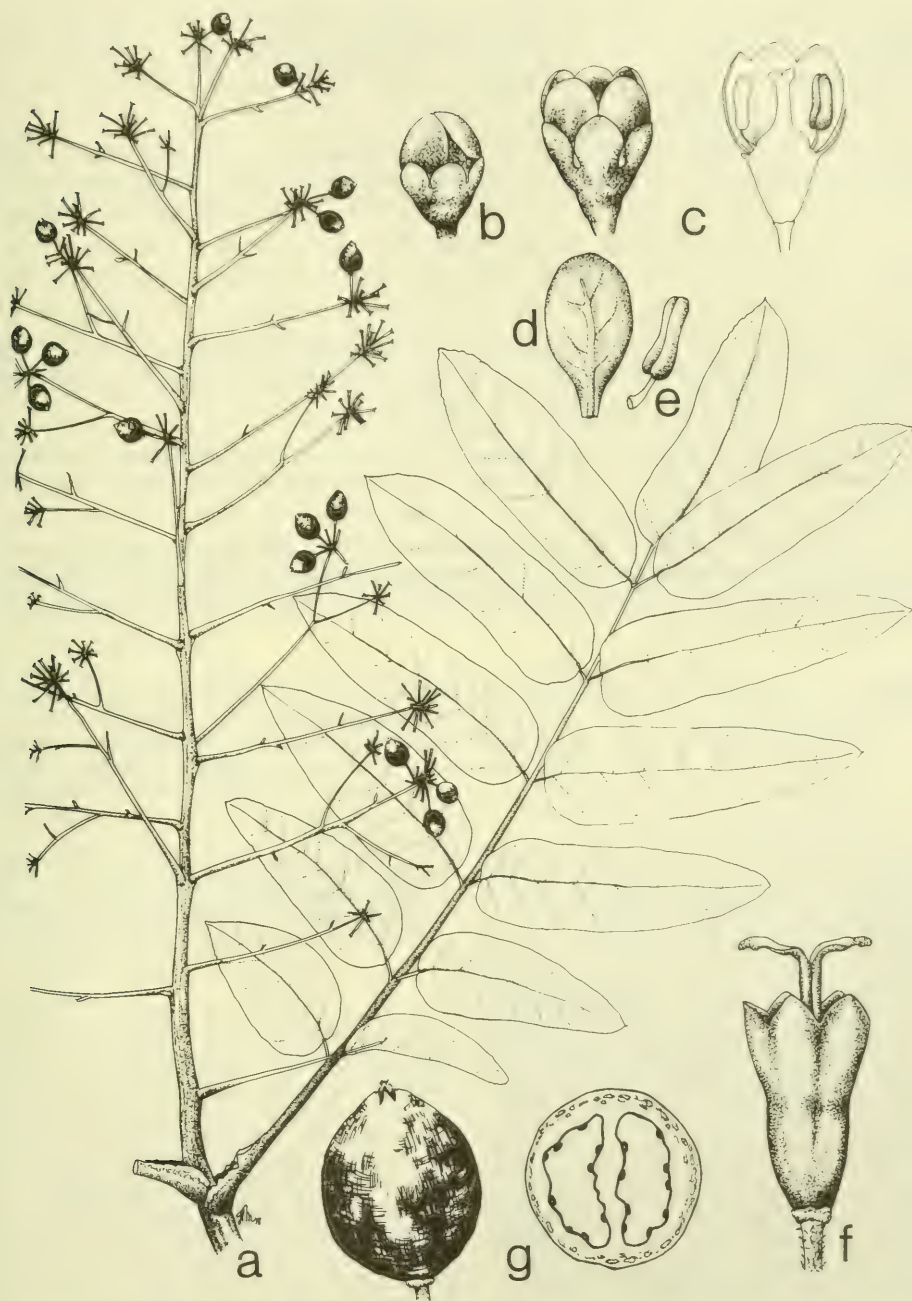


Fig. 7. *Delarbrea collina* VIEILL. *a*. Habit,  $\times \frac{2}{5}$ , *b*. flower bud, *c*. flower and ditto in LS, *d*. petal, *e*. stamen, *f*. flower after anthesis,  $\times 13$ , *g*. fruit and ditto in CS,  $\times 3$  (*a-e, g* RIDSDALE NGF 36736, *f* SOEKMA *s.n.*).  
 Drawn by HÉLÈNE MULDER.

## 4. DELARBREA

VIEILL. Bull. Soc. Linn. Norm. 9 (1865) 342, 393; BTH. in B. & H. Gen. Pl. 1 (1865) 935; BRITTEN in Forbes, Nat. Wand. (1885) 506 (see also p. 354); HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 61; in K. Sch. & Laut. Fl. Schutzgeb. (1900) 485; HUTCH. Gen. Fl. Pl. 2 (1967) 63. — **Fig. 7.**

Glabrous unarmed shrubs or small trees. *Leaves* large, imparipinnate, with a stipular sheath; leaflets alternate or opposite, entire or indistinctly dentate. *Flowers* in umbellules grouped in large terminal panicles; pedicels articulated below the flower. Calyx lobes 5. Petals 5, imbricate, obovate, narrowed towards the base. *Stamens* 5, filaments stout, anthers dorsifixed. Ovary inferior, 2-celled, disk fleshy, obconic, crowned by two erect styles with clavate stigmas. *Fruit* ovoid, crowned by the small calyx lobes and the recurved style arms (which eventually fall); exocarp thin, fleshy, with peripheral oil vesicles; endocarp papery; endosperm with shallow longitudinal grooves not ruminant.

Distr. Queensland, Melanesia and East Malesia, 3 or 4 *spp.*, from the Lesser Sunda Is. eastwards to New Guinea (also New Britain), Queensland, Solomons, New Caledonia, and New Hebrides. In *Malesia* 1 *sp.*

Ecol. Lowland to montane forest.

Note. The corolla is distinctive, the petals being strongly imbricate and narrowed towards their insertion. The fruit also has a characteristic appearance, since the calyx and stylopodium, although persistent, do not enlarge as in most other araliads. The fruit, therefore, is a smooth ellipsoid berry without a prominent rim around the apex.

**1. *Delarbrea collina* VIEILL.** Bull. Soc. Bot. Norm. 9 (1865) 342; PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 18. — *D. sp.* HEMSL. Rep. Challenger, Bot. 1, pt 3 (1885) 155. — *D. paradoxa* (non VIEILL.) BRITTEN in Forbes, Nat. Wand. (1885) 506. — *D. lauterbachii* HARMS in K. Sch. & Laut. Fl. Schutzgeb. (1900) 485.

Sparsely branched shrub to 5 m high, with the multijugate leaves clustered at the ends of the branches. *Leaves* c. 70–100 by 30–40 cm; rachis not articulated; leaflets alternate or in pairs, c. 7 on each side; petiolules c. 1 cm long; lamina c. 17–20 by 4–6½ cm, lanceolate, ovate, oblong or elliptic, gradually tapered to an acute apex, base truncate, rounded or cuneate, usually oblique, margin entire; petiole c. 17–20 cm, terete, lenticellate, with a heavily lenticellate clasping base with membranous margins. *Inflorescence* a terminal panicle of umbellules, rachis up to 60 cm long, bearing well-spaced secondary branches 6–25 cm long, bracts caducous; tertiary branches c. 2–8 cm long, terminating in a circlet of broadly ovate bracts (mostly caducous) surrounding the umbellules, sometimes with smaller (male) lateral umbellules; umbellules c. 2 cm Ø at anthesis, with c. 30–40 flowers. Pedicels c. 5 mm (elongating to 10–15 mm in fruit), pustulate. *Calyx* lobes 5, obtuse, united below into a tube. Petals 5, c. 1½ by ¾ mm, keeled within. Stamens 5, 1 mm long. Ovary sometimes prominently ribbed when dry, c. 2 mm long; disk

and styles c. 1 mm high at anthesis. *Fruit* 16 by 10 mm, purplish black when mature.

Distr. Solomon Is. to New Caledonia and Queensland; in *Malesia*: Lesser Sunda Is. (Timor, Wetar, Babar), Moluccas (Tenimber Is., Banda), New Guinea (Aru Is., Kar Kar Is., Madang, New Britain). Fig. 8.

Ecol. Rain-forest, from sea-level to 1000 m.

Vern. *Don*, Madang.

Notes. The most wide-ranging of any Malesian araliad. It was collected in Malesia by FORBES in

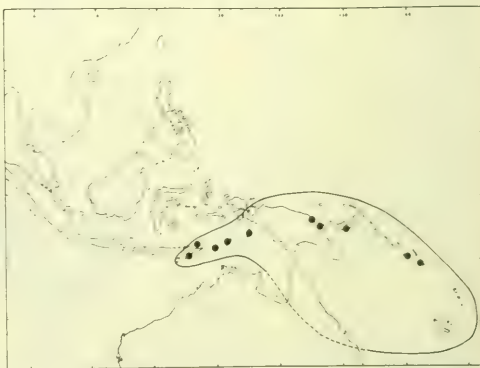


Fig. 8. Range of *Delarbrea collina* VIEILL., localities in Malesia dotted.



Timor in 1882, when it was incorrectly identified as the New Caledonian species *D. paradoxa* VIEILL. Eight years earlier it had been collected in the Aru Is. during the Challenger Expedition (HEMSLEY, *l.c.*) and also been referred as close to *D. paradoxa*. Nearly twenty years later LAUTERBACH collected it in the Moluccas, when HARMS described it as a new species. The statement by HARMS that the genus was known previously only from New Caledonia cannot be reconciled with his note in the Pflanzenfamilien in which he recorded

BRITTEN's report of it in Timor. Solomon Islands collections were identified as *D. collina* VIEILL. by PHILIPSON in 1951. The arrangement of the umbellules differs in the panicles of *D. collina* and *D. paradoxa*. All the material from Malesia conforms to the characters of *D. collina*. The plant is evidently rare, few collections having been made in spite of its wide distribution.

It was formerly cultivated in the Botanic Garden at Bogor until about 1958, having been introduced from Banda.

## 5. PENTAPANAX

SEEM. J. Bot. 2 (1868) 294; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 55; KOORD. Bull. Jard. Bot. Btzig III, 1 (1919) 181; HUTCH. Gen. Fl. Pl. 2 (1967) 63; NGOC-SANH BUI, Adansonia 9 (1969) 389; PHILIPSON, Austrobaileya 1 (1977) 23. — Fig. 9.

Trees or shrubs, often scandent, unarmed. *Leaves* imparipinnate, exstipulate, glabrous. *Flowers* in racemes or umbels, which are arranged in panicles or compound umbels, pedicels articulated below the ovary. *Calyx* 5. Petals 5, imbricate in the bud. *Stamens* 5. Ovary inferior, 5-celled, disk  $\pm$  conical, surmounted by the styles which are united their whole length or become free down to half their length. *Fruit* globose; exocarp leathery, enclosing crustaceous pyrenes. Seeds compressed, endosperm smooth.

Distr. About 14 *spp.* in India, Thailand, Vietnam, Ceylon, Burma, southern China, Taiwan, in *Malesia*: 1 *sp.* locally in E. Java.

South American species formerly included are best excluded, and the 2 Queensland *spp.* are now referred to *Polyscias*.

Ecol. Forest and scrub.

**1. *Pentapanax elegans*** KOORD. Bull. Jard. Bot. Btzig III, 1 (1919) 182, pl. 16 & 17; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 17; BACK. & BAKH. f. Fl. Java 2 (1965) 169. — Fig. 9.

*var. elegans.*

Epiphytic scrambler or terrestrial shrub up to 10 m, with unarmed branches, leaf and flower buds separate, enclosed in  $\pm$  persistent imbricated cataphylls. *Leaves* disposed along the branches; petiole c. 6–10 cm, flattened above, base scarcely dilated, and sometimes minutely fimbriated, articulated with the rachis, and the rachis articulated with the petiolules, articulations minutely fimbriate, rachis to 5 cm, petiolules of lateral leaflets up to 5 mm, of terminal leaflet to 20 mm, leaflets 5 or fewer, ovate to oblong-elliptic, the lateral sometimes oblique, up to 10 by 7 cm, usually c. 5 by 2½ cm, apex acute, base rounded or cuneate, margin entire or with subulate teeth, glaucous beneath. *Inflorescence* terminal with persistent cataphylls at the base of the main axis, umbels solitary or 1–4 smaller (apparently male) lateral

umbels arising from the axils of minute bracts on the rachis; rachis 8–16 cm, slender, glabrous; terminal umbel 3–6 cm  $\varnothing$ , many-flowered; pedicels 1½–3 cm, filiform, glabrous, with minute bracteoles surrounding the articulation below the flower. *Calyx* lobes ligulate, obtuse, c. 1 mm long; petals triangular to ligulate c. 2 mm long; filaments yellow, 3 mm, anthers purple, ½ mm long. Ovary broadly obconic, surmounted by a stylar column, 2 mm long. *Fruit* globose, 3–4 mm  $\varnothing$ , disk broadly conical, crowned by the persistent calyx lobes and an awl-shaped stylar column which may divide at apex.

Distr. *Malesia*: E. Java (Mts Ardjuno and Tengger), the variety in Thailand.

Ecol. Uncommon, in light forest or scrub, including *Casuarina junghuhniana* forest, 1700–2600 m.

Note. A remarkably isolated species of a genus otherwise unrepresented in *Malesia*.

***var. pubescens*** KOORD. Bull. Jard. Bot. Btzig III, 1 (1919) 183 (as *var. puberula* in f. 17); NGOC-SANH BUI, Adansonia 9 (1969) 389.



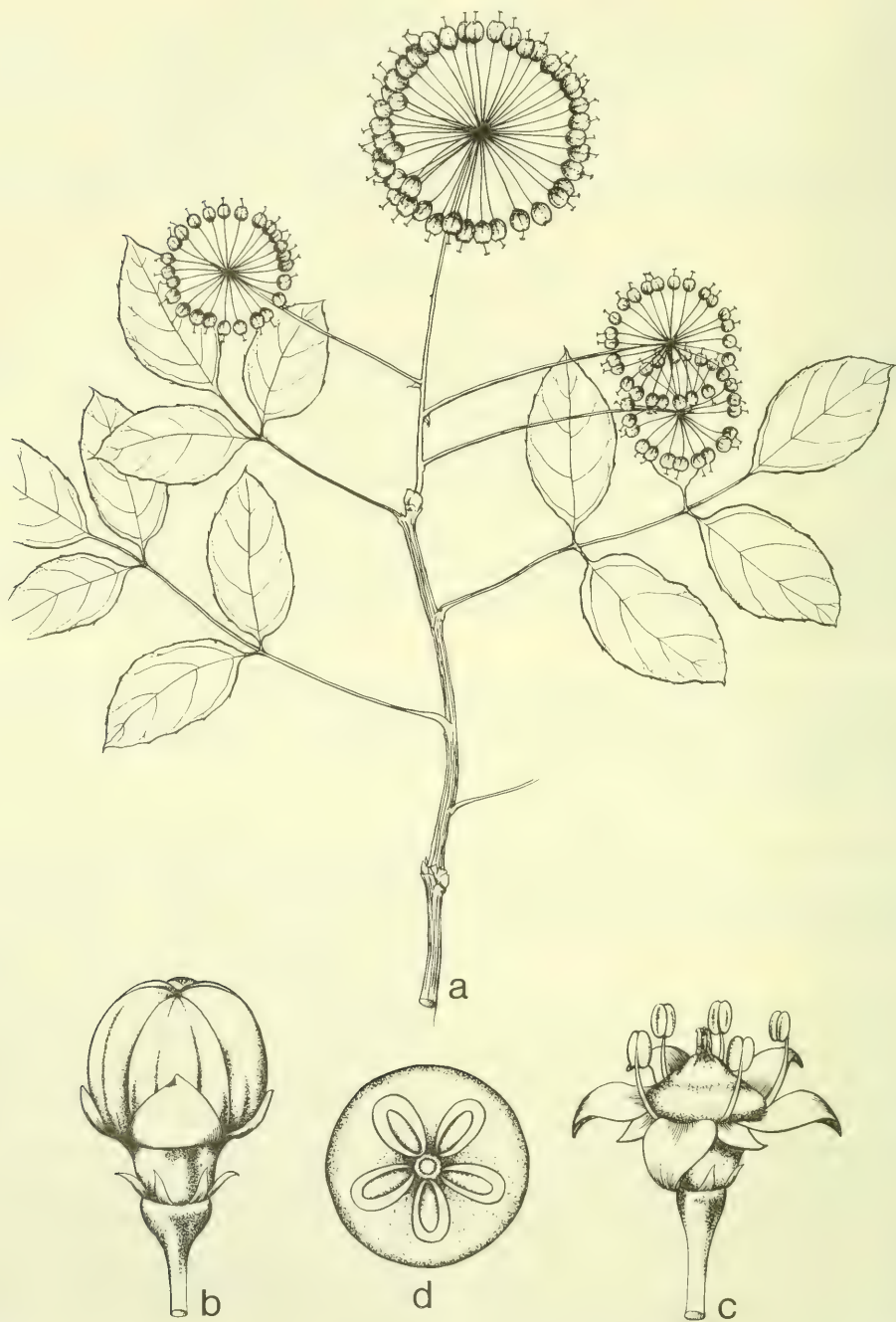


Fig. 9. *Pentapanax elegans* KOORD. a. Habit,  $\times \frac{1}{2}$ , b. flower bud, c. flower in anthesis, d. ovary in CS, enlarged (VAN STEENIS 10879). Drawn by P. PRENDERGAST.

Peduncle and pedicels tomentose.  
Distr. Thailand; in *Malesia*: E. Java (Mt Jang).  
Ecol. In *Casuarina junghuhniana* forest, scat-  
tered, 1900–2300 m.

Note. Since all specimens from Mts Tengger  
and Ardjuno lack pubescence, the retention of the  
variety appears justified. However, more collections  
are required from all localities.

6. MACKINLAYA

F.v.M. Fragm. 4 (1864) 119; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 62; Bot. Jahrb. 56 (1921) 413; PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 3; HUTCH. Gen. Fl. Pl. 2 (1967) 65. — *Anomopanax* HARMS [in Dalla Torre & Harms, Gen. Siph. (1903) 364, *nomen*;] Ann. Jard. Bot. Btzg 19 (1904) 13; in K. Sch. & Laut. Nachtr. (1905) 332; in E. & P. Nat. Pfl. Fam. Nachtr. 3 (1908) 255; Bot. Jahrb. 56 (1921) 414; HUTCH. Gen. Fl. Pl. 2 (1967) 59. — **Fig. 10.**

Glabrous unarmed shrubs, often unbranched (sympodial). *Leaves* with a petiole having a dilated sheath encircling the stem and (in dried material) a constriction at the apex, and with a leaf-blade either unifoliate or digitately compound, the central leaflet, or the three central leaflets, sometimes digitately lobed or compound. *Inflorescence* terminal (but sympodium often continued by axillary branching), the peduncle bearing umbellately arranged branches which terminate either in umbellules or in cymes. *Flowers* male or hermaphrodite, the male flowers either in distinct inflorescences or towards the periphery of mixed inflorescences. Pedicel articulated below the flower. *Calyx* lobes 5–6, triangular or lanceolate. Petals 5–6, narrowed below into a distinct claw, and above into a long incurved process. *Stamens* 5–6; anthers subglobose. Ovary inferior, with two uni-ovulate cells. Disk prominent, with a crenulate margin. Styles 2, subulate, free, recurved in fruit. *Fruit* strongly compressed, 2-seeded (or one aborted), with a longitudinal furrow between the seeds; exocarp leathery, endocarp cartilaginous. Endosperm smooth.

Distr. 5 *spp.*, Solomon Is., Queensland, and in *Malesia* (3 *spp.*): Philippines, Celebes and throughout New Guinea.  
Ecol. Understorey of rain-forest and montane forest, or epiphytic. Also in secondary growth.  
Notes. The leaves are palmately divided or they may be reduced to a single leaflet, especially on the upper branches of *M. schlechteri*. The central leaflet, or the three central leaflets, are either lobed or compound, a character rarely found in other genera of this family. Another foliar character rare in the family is the insertion of the leaf-sheath round the whole circumference of the stem. This character occurs also in a section of *Polyscias*, but is more typical of *Umbelliferae*. The narrow base of the petal is also very rare in the family, but is characteristic of *Umbelliferae*. The constantly 2-celled ovary is also typical of *Umbelliferae*, but other characters of the fruit appear to justify the retention of these plants in the *Araliaceae*. Reasons for regarding *Anomopanax* as congeneric with *Mackinlaya* are given by PHILIPSON (*l.c.*).

KEY TO THE SPECIES

1. Ultimate branches of the inflorescence in irregular cymes . . . . . 1. *M. celebica*
1. Ultimate branches of the inflorescence in umbellules.
2. Primary rays of the inflorescence many (30–50) . . . . . 2. *M. radiata*
2. Primary rays of the inflorescence c. 15 or fewer . . . . . 3. *M. schlechteri*

1. *Mackinlaya celebica* (HARMS) PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 8. — *Anomopanax celebicus* HARMS, Ann. Jard. Bot. Btzg 19 (1904) 14; Ic. Bog. 2 (1906) t. 176 & 177. — *Anomopanax philippinensis* HARMS, Ann. Jard. Bot. Btzg 19

(1904) 15. — *Anomopanax warburgii* HARMS, *l.c.* 15. — *M. amplifolia* HEMSL. Kew Bull. (1909) 260; HARMS, Bot. Jahrb. 56 (1920) 413. — *Anomopanax arfakensis* GIBBS, Arfak (1917) 163. — *Anomopanax digitata* MERR. Philip. J. Sc. 17



Fig. 10. *Mackinlaya celebica* (HARMS) PHILIPSON. *a.* Part of inflorescence,  $\times \frac{2}{5}$ , *b.* leaf, *c.* leaflet,  $\times \frac{2}{3}$ , *d.* flower cluster, *e.* flower,  $\times 7$ , *f.* petal,  $\times 13$ , *g.* fruit,  $\times \frac{5}{6}$  (BRASS 28056). Drawn by HELENE MULDER.



(1920) 301. — *Polyscias cibaria* WHITE & FRANCIS ex LANE-POOLE, For. Res. (1925) 129, descr. angl. *minim.* — *Anomopanax variifolius* C. T. WHITE, J. Arn. Arb. 10 (1929) 256. — *M. digitata* (MERR.) PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 7. — *M. warburgii* (HARMS) PHILIPSON, l.c. 8. — Fig. 10.

Shrub or small sparsely branched tree to 6 m. *Leaves* very variable in size and complexity; petiole up to 52 cm,  $1\frac{1}{4}$  cm wide, terete, striate, with a membranous base ensheathing the stem; leaflets 5 (rarely 3) or the central petiolule (or the central 3 petiolules) frequently dividing to bear three, or more rarely 5 leaflets; lateral petioles short (c. 1–2 cm), the three central longer (up to 12 cm); lamina elliptic or ovate, up to 48 by 22 cm, base abruptly attenuated into the petiolule or subcordate, apex acuminate or gradually narrowed, acute, margin entire, denticulate or coarsely serrate, especially towards the apex, membranous, lamina of the terminal leaflet (and less frequently of the central three leaflets) sometimes deeply 3-lobed or with 3–5 separate leaflets, of which the lateral are markedly oblique at the base. *Inflorescence* a terminal compound umbel, very variable in size, either entirely of male flowers or with male and hermaphrodite flowers, often overtopped by sympodial growth; peduncle terete, striate, stout, up to 30(–45) cm,  $\frac{3}{4}$  cm  $\varnothing$ , bearing lanceolate bracts below the rays; primary rays c. 9–18, 10–20 cm, striate, with distal small linear bracts; secondary rays about 5–10, 3–6 cm, dividing again (often repeatedly) either umbellately or in an irregular cymose manner, the central ray frequently more strongly developed. *Calyx* lobes 5, triangular, c. 1 mm long. *Petals* 5, obovate c.  $1\frac{1}{2}$  mm long. *Filaments* c.  $1\frac{1}{2}$  mm, anthers small. *Ovary* obconic, 1–2 mm long, narrowly turbinate in male flowers, ovoid and quickly swelling in female flowers. *Fruit* up to  $2\frac{1}{2}$  by 3 cm, compressed, rotund, constricted in the mid-axis, the two halves frequently unevenly developed.

Distr. Solomon Is.; in *Malesia*: New Guinea (incl. New Britain and Aru Is.), Celebes, and Central & S. Philippines.

Ecol. Rain-forest, open hill forest, and montane forest, also in secondary growths, from sea-level to 1450 m.

Uses. LANE-POOLE (l.c.) recorded that at Mt Obree leaves and flowers are cooked with coconut oil and put in armlets in dances.

Vern. Philippines: *binlaon*, C.Bis., *pararau*, Bag., *tagima*, Sub., *lumot-lumot*, Mindanao; New Guinea: *bugini*, *wale*, *yam bonga*, Sepik Distr., *lak-lak*, W. Highlands, *po'undo*, S. Highlands, Papua, *nere*, Central Distr., Papua, *narona*, New Britain.

Notes. The leaves have a strong parsley-like odour. The flowers are creamy white, and the fruits blue to purple with a glaucous bloom. Salt is said to be obtained from the ashes of the leaves.

Although collected frequently in the Philippines and New Guinea, this species is unrecorded for the Moluccas. There is considerable variation in the size of the leaves and of the inflorescence. A few New Guinea specimens are intermediate in character between this and the equally common *M. schlechteri*, and are interpreted as hybrids.

## 2. *Mackinlaya radiata* PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 6.

Slender shrub to 5 m. Petiole c. 20 cm, terete and finely striate, base ensheathing the stem, membranous. *Leaflets* 5, or the central petiolule bearing three leaflets, the two lateral petiolules short (1– $1\frac{1}{2}$  cm), the three central longer (6–8 cm, or the midpetiolule to 11 cm); lamina of the lateral leaflets elliptic or ovate, up to 20 by 12 cm, base abruptly attenuated into the petiolule, apex gradually narrowed, acute, margin entire or minutely denticulate towards the apex, membranous; lamina of the central leaflet similar or deeply 3-lobed or with 3 separate leaflets of which the lateral are strongly oblique at the base. *Inflorescence* a terminal compound umbel; peduncle terete, striate, stout, from 20 cm to considerably longer, 4–6 mm  $\varnothing$ , bearing lanceolate bracts below the rays; primary rays numerous (c. 30–50), 9–18 cm, slender, striate, with distal minute, linear, caducous bracts; secondary rays (pedicels) numerous (35–130), filiform, 1–2 cm; outer flowers male, central hermaphrodite. *Calyx* lobes 5, narrowly triangular, c.  $\frac{1}{2}$  mm long. *Petals* 5, obovate, c. 1 mm long. *Ovary* narrowly obconic in male flowers, ovoid in hermaphrodite flowers, c. 0.7 mm long. *Fruit* (immature) ovate, compressed.

Distr. *Malesia*: New Guinea (NW. Irian; Sepik Distr.).

Ecol. Montane rain-forest and mossy forest, 900–1200 m.

Vern. *Apiyetimber*, Sepik Distr.

Note. Flowers creamy white.

3. *Mackinlaya schlechteri* (HARMS) PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 7. — *Anomopanax schlechteri* HARMS in K. Sch. & Laut. Nachtr. (1905) 332, t. 13. — *Anomopanax versteegii* HARMS, Nova Guinea 8 (1910) 276. — *M. versteegii* (HARMS) PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 7. — *M. brassii* PHILIPSON, l.c. 6. — *M. klossii* PHILIPSON, l.c. 6. — *M. subulata* PHILIPSON, l.c. 7.

Slender shrub to 6 m. *Leaves* 1–3 (rarely 4-) foliolate. Petiole usually less than 10 cm, but occasionally longer (to 20 cm), especially in compound leaves, terete and finely striate, base ensheathing the stem, membranous. *Lamina* elliptic obovate, or oblong, occasionally irregularly lobed, up to 28 by 12 cm but usually considerably smaller, base cuneate or truncate (of lateral leaflets often

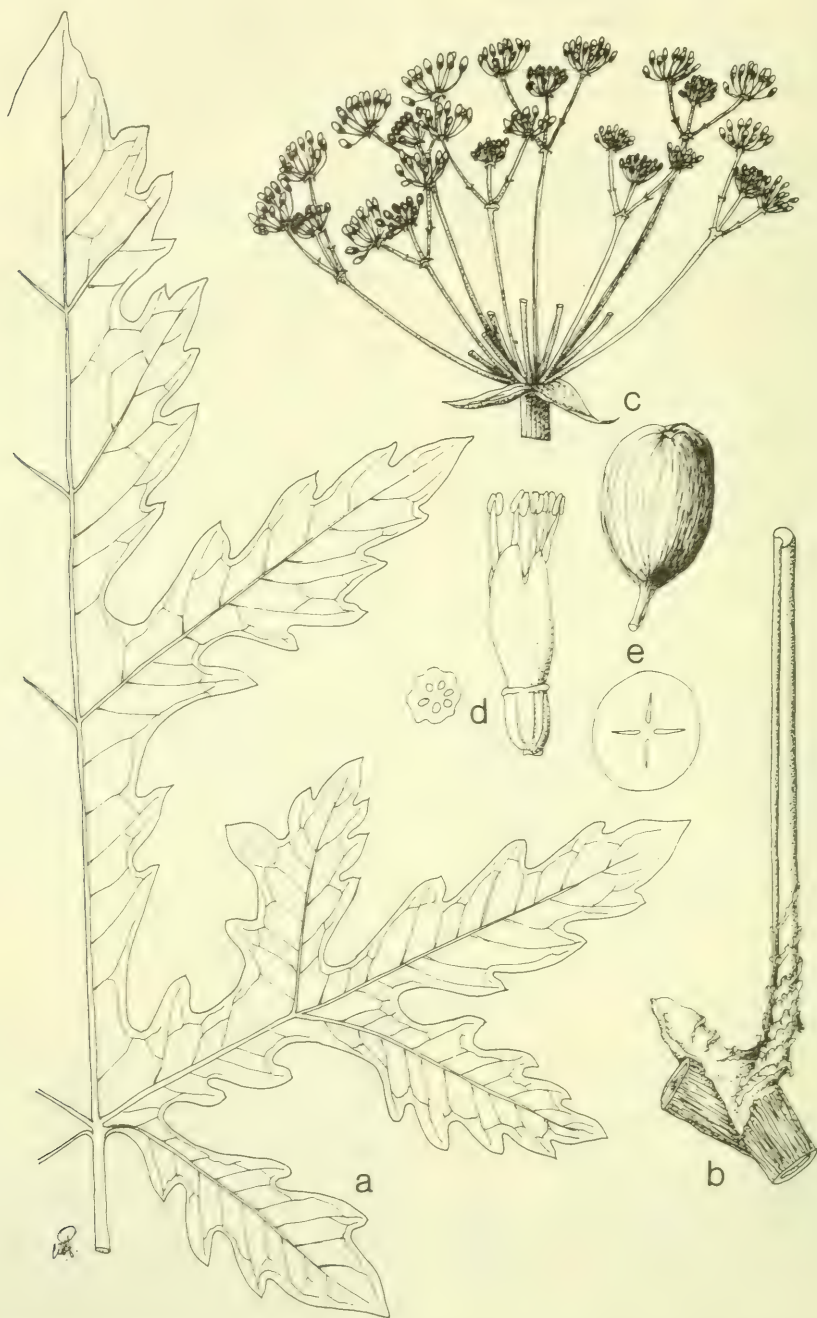


Fig. 11. *Osmoxylon novoguineense* (SCHEFF.) BECC. a. Leaf half, b. base of petiole, both  $\times \frac{2}{5}$ , c. inflorescence,  $\times \frac{4}{5}$ , d. flower and CS of ovary,  $\times 4$ , e. false fruit and ditto in CS (Craven & Schodde 789).  
 Drawn by W. R. PHILIPSON.



oblique), apex shortly acuminate, acute, margin entire or dentate towards the apex, membranous or chartaceous. *Inflorescence* a terminal compound umbel, often overtopped by a lateral branch at its base; peduncle terete, striate, c. 10–20 cm, bearing small lanceolate bracts below the rays; primary rays 6–15, c. 4–7 cm, striate, with minute distal caducous bracts; secondary rays (pedicels) c. 10–20, filiform or rather rigid, usually 5–12 mm; male flowers towards the outside of the umbellules. *Calyx* lobes 5, triangular to subulate,  $\frac{1}{2}$ –1 mm long. Petals 5, obovate. Ovary narrowly turbinate, in male flowers obconic or ovoid, c.  $\frac{3}{4}$  mm long in hermaphrodite. *Fruit* large, 15 by 22 mm, compressed, rotund, constricted above and below on the central axis; styles persistent, recurved.

*Distr. Malesia*: New Guinea (along the Central Ranges, from the Star Mts east to Meyamya), also in New Britain.

*Ecol.* Rain-forest and montane forest, 600–2300 m.

*Uses.* The cut stem exudes a viscous sap which is an irritant. The leaves are aromatic. The plant is reported to be poisonous and to have a number of medicinal uses. The boiled leaves are eaten to

reduce fever and to relieve 'korima'. Pieces of leaf placed in a cavity relieve toothache. The leaves are wrapped around taro at planting to encourage growth.

*Vern.* *Dako*, Wissel Lakes, *kolobang*, *kulbang*, Sepik Distr., *auke*, *kenata*, *muklofo*, E. Highlands, *narona*, New Britain.

*Notes.* The flowers are white and the ripe fruit mauve to purple with a glaucous bloom.

A large number of collections made in recent years throughout New Guinea all have regularly compound umbels with the flowers borne on branches of the third degree in the form of strict umbels. In two of the earliest gatherings (SCHLECHTER 14365 and VERSTEEG 1419) the third degree branches frequently divide again either umbellately or cymosely. These two specimens were described as species by HARMS. PHILIPSON later (1951) kept the forms with regular umbellules separate (describing three species). All these five entities are now considered conspecific, the SCHLECHTER and VERSTEEG specimens being regarded as rare anomalies in a widespread and abundant species. It is possible that the VERSTEEG plant is a hybrid with *M. celebica*.

## 7. OSMOXYLON

MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 5; BTH. in B. & H. Gen. Pl. 1 (1865) 944; BECC. Malesia 1 (1878) 193; BOERL. Ann. Jard. Bot. Btzig 6 (1887) 123; O. K. Rev. Gen. Pl. 1 (1891) 645; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 32; Bot. Jahrb. 56 (1920) 384; HUTCH. Gen. Fl. Pl. 2 (1967) 73; PHILIPSON, Blumea 23 (1976) 99. — *Eschweilera* ZIPP. ex BOERL. Ann. Jard. Bot. Btzig 6 (1887) 112, non *Eschweilera* MART. 1828; Handl. 1 (1890) 640. — *Pseudosandalum* O. K. Rev. Gen. Pl. 1 (1891) 271 ('*Pseudosantalum*'), nom. illeg. — *Boerlagiodendron* HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 31; in K. Sch. & Laut. Fl. Schutzgeb. (1900) 484; Bot. Jahrb. 56 (1920) 377; HUTCH. Gen. Fl. Pl. 2 (1967) 72. — **Fig. 11, 13–16.**

Unarmed, glabrous or tomentose shrubs or trees. *Leaves* palmately lobed or simple, rarely digitately compound; stipules forming a ligule, and the base of the petiole furnished with one to several spiral or transversal crests or collars (very rarely absent). *Inflorescence* a terminal compound umbel; peduncle short; primary rays each terminating into three branches; the central branch bearing a head or umbellule of almost always sterile bacciform flowers ('pseudo-fruits'); the two lateral branches each bearing a head or umbellule of hermaphrodite flowers. *Calyx* an obsolete rim or 0. Corolla with few to many lobes above, tubular below. *Stamens* 4–30, filaments thick, anthers oblong, exserted. Ovary inferior, not articulated with the pedicel, cells 1–many; disk flat with a central raised boss bearing the pustulate stigmas. *Fruit* subglobose (ribbed when dry); exocarp fleshy, endocarp crustaceous. *Seeds* compressed, endosperm smooth or wrinkled.

*Distr.* About 50 spp., of which 40 occur in *Malesia*, extending from Borneo and the Philippines eastwards through Celebes and Moluccas to New Guinea, the remainder lying further north and east in Taiwan, Micronesia, Melanesia and the New Hebrides. **Fig. 12.**



Ecol. Mainly understorey trees in primary rain-forest, also in second growth forest, usually at low altitudes, especially in shaded situations and near rivers, 15. *O. borneense* a characteristic rheophyte.

Notes. The foliage, inflorescence and flowers of this genus are all unique within the family. The base of the petiole often bears a spiral crest, or this may form a simple collar; the blade varies from simple to elaborately compound; the inflorescence is composed of trifid rays, the central branch bearing sterile bacciform flowers; the corolla is tubular.

The central bacciform flowers (pseudo-fruits) are sterile, except in 12. *O. yatesii*, in which apparently mature seed was once found.

By exception a specimen of 40. *O. luzoniense* had apparently fertile flowers on the central branches of the inflorescence.

#### KEY TO THE SPECIES

1. Leaves simple, without lobes.
  2. Petiole base without crests (New Guinea) . . . . . 1. *O. miquellii*
  2. Petiole base with 1 or more crests.
    3. Petiole base with several crests (Philippines) . . . . . 8. *O. oblongifolium*
    3. Petiole base with a single collar-like crest.
      4. Fertile flowers pedicelled (Philippines).
        5. Leaf obovate to oblanceolate, petiole 3 cm or less . . . . . 2. *O. dinagatense*
        5. Leaf elliptic, petiole 5 cm or more . . . . . 3. *O. simplicifolium*
      4. Fertile flowers sessile (or subsessile).
        6. Leaf broadly obovate (Solomons) . . . . . 4. *O. spathipedunculatum*
        6. Leaf lanceolate or narrowly obovate.
          7. Pseudo-fruits pedicelled (Moluccas) . . . . . 5. *O. articulatum*
          7. Pseudo-fruits sessile.
            8. Inflorescence c. 60 cm  $\varnothing$  (Moluccas) . . . . . 6. *O. umbelliferum*
            8. Inflorescence c. 30 cm  $\varnothing$  (New Ireland) . . . . . 7. *O. lanceolatum*
    1. Leaves lobed or digitately compound.
      9. Leaves digitately compound.
        10. Ovary 10–16-celled (New Guinea) . . . . . 13. *O. geelvinkianum*
        10. Ovary 4–5-celled.
          11. Leaflets lobed (Philippines).
            12. Primary rays of inflorescence c. 10 or fewer . . . . . 9. *O. catanduanense*
            12. Primary rays of inflorescence more than 20.
              13. Inflorescence c. 16–20 cm  $\varnothing$ . . . . . 10. *O. caudatum*
              13. Inflorescence c. 5–6 cm  $\varnothing$ . . . . . 11. *O. heterophyllum*
          11. Leaflets entire.
            14. Leaflets elliptic-oblong to ovate (Philippines) . . . . . 12. *O. yatesii*
            14. Leaflets linear-lanceolate.
              15. Leaflets 4–7, petiole 4–6 cm (Philippines) . . . . . 14. *O. lineare*
              15. Leaflets 9 or more, petiole longer than 10 cm (Borneo) . . . . . 15. *O. borneense*
      9. Leaves lobed (sometimes smaller simple leaves below inflorescence).
        16. Pseudo-fruits sessile.
          17. Petiolar crests long-pectinate. Bracts of the peduncle heavily setose (Philippines)
            16. *O. pulcherrimum*
          17. Petiolar crests fimbriate or undulate. Bracts of the peduncle not setose (Moluccas).
            18. Lateral inflorescence branches with opposite, persistent bracts close to the base 17. *O. soelaense*
            18. Lateral inflorescence branches with scars of opposite caducous bracts near the middle
              18. *O. globulare*
      16. Pseudo-fruits pedicelled.
        19. Lateral inflorescence branches without an articulation.
          20. Petiolar base with a single collar-like crest (Borneo) . . . . . 19. *O. kostermansii*
          20. Petiolar base with several crests.
            21. Petiolar crests long-pectinate.
              22. Fertile flowers pedicelled. Stamens at least 7 (Key Is.) . . . . . 20. *O. barbatum*
              22. Fertile flowers sessile (or subsessile). Stamens 5 (Bismarck Arch.) . . . . . 21. *O. pfeilli*
            21. Petiolar crests fimbriate or undulate.
              23. Stamens and ovary cells more than 5. Flowers usually pedicelled (Moluccas) 22. *O. palmatum*
              23. Stamens and ovary cells 4. Flowers sessile or subsessile (Philippines). . . . . 23. *O. ramosii*
      19. Lateral inflorescence branches with an articulation (2 bracts or bract-scars).

24. Fertile flowers pedicelled.

25. Pedicels of fertile flowers longer than 7 mm (New Guinea) . . . . . 24. *O. novoguineense*

25. Pedicels of fertile flowers 5 mm or shorter.

26. Ovary cells 7 or more.

27. Leaf lobes elliptic (Celebes) . . . . . 25. *O. teysmannii*

27. Leaf lobes pinnatilobed (Batjan) . . . . . 41. *O. insigne*

26. Ovary cells 4–5.

28. Petiolar crests ± entire (Philippines) . . . . . 26. *O. humile*

28. Petiolar crests with long setae.

29. Leaves coriaceous, margin thickened, teeth obtuse (Philippines) . . . . . 27. *O. pectinatum*

29. Leaves membranaceous, margin not thickened, teeth setulose (Celebes)

28. *O. masarangense*

24. Fertile flowers sessile (or if subsessile bracteoles longer than the very short pedicels).

30. Ovary cells 10 or more (New Guinea).

31. Flower buds large (c. 9–12 mm long). Primary rays of inflorescence very strong

29. *O. insidiator*

31. Flower buds smaller (c. 4–6 mm long). Primary rays of inflorescence more tenuous.

32. Heads of fertile flowers ± discoid at anthesis . . . . . 30. *O. boerlagei*

32. Heads of fertile flowers globose . . . . . 31. *O. sessiliflorum*

30. Ovary cells 6 or fewer.

33. Leaf lobes lanceolate.

34. Leaf lobes 4–7; petiole 4–6 cm (Philippines) . . . . . 14. *O. lineare*

34. Leaf lobes 9 or more; petiole longer than 10 cm (Borneo) . . . . . 15. *O. borneense*

33. Leaf lobes broader.

35. Leaf surfaces retaining some trace of setulose tomentum. Umbellules of pseudo-fruits small (8 mm Ø or less) (New Guinea) . . . . . 38. *O. micranthum*

35. Leaf surfaces glabrous at maturity. Umbellules of pseudo-fruits larger (1 cm Ø or more).

36. Ovary cells 3 (Philippines).

37. Petiolar crests ± entire . . . . . 32. *O. camiguinense*

37. Petiolar crests long-pectinate . . . . . 33. *O. fenicis*

36. Ovary cells 4 or more.

38. Umbellules of pseudo-fruits large (3–5 cm Ø) (Philippines).

39. Primary rays of the inflorescence 9–12 cm long. Leaves with strong radiating veins, usually more than 11. . . . . 34. *O. eminens*

39. Primary rays of the inflorescence 4–5 cm long. Leaf-veins less strongly developed, usually fewer than 11 . . . . . 35. *O. serratifolium*

38. Umbellules of pseudo-fruits smaller (2½ cm Ø or less).

40. Leaf with a small triangular lobe below the middle of each side of the blade (not strictly palmately lobed) (Philippines) . . . . . 8. *O. oblongifolium*

40. Leaf palmately lobed.

41. Petiolar crests long-pectinate (Celebes) . . . . . 36. *O. celebicum*

41. Petiolar crests fimbriate, entire, or undulate.

42. Articulation of lateral branches of umbels close to the base (Talaud Is.)

37. *O. talaudense*

42. Articulation of lateral branches of umbels near the middle.

43. Inflorescence over 20 cm Ø (New Guinea) . . . . . 31. *O. sessiliflorum*

43. Inflorescence under 20 cm Ø (Philippines).

44. Leaf usually 3-lobed. Inflorescence rays delicate, indistinctly setose to glabrous

39. *O. trilobatum*

44. Leaf usually 5–7-lobed. Inflorescence rays sturdy, markedly setose 40. *O. luzoniense*
1. *Osmoxylon miquelii* BOERL. Ann. Jard. Bot. Btztg 6 (1887) 125, t. 16; HARMS, Bot. Jahrb. 56 (1920) 384; PHILIPSON, Blumea 23 (1976) 103. — *O. amboinense* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 6, p.p.; BECC. Malesia 1 (1878) 194, p.p. — *Gastonia simplicifolia* ZIPP. ex SEEM. J. Bot. 3 (1865) 75, nomen in synon.; ex BOERL. Ann. Jard. Bot. Btztg 6 (1887) 125, nom. inval. in synon. — *Pseudosandalum miquelii* (BOERL.) O. K. Rev. Gen. Pl. 1 (1891) 271.

Sparsely branched tree, 15 m. *Leaves* glabrous, simple, subcoriaceous; stipules small forming a bicuspid ligule; petioles long (to 19 cm), swollen distally; blade oblong-elliptic, 22–36 by 9–12 cm, subrounded at base and apex or mucronulate, midrib prominent below, secondary veins arched-ascending and uniting, c. 1–2 cm apart, margin entire to undulate. *Umbel* terminal, sessile, with many (28–32) radiating rigid, angular, trifid branches c. 7 cm long to first joint. Central



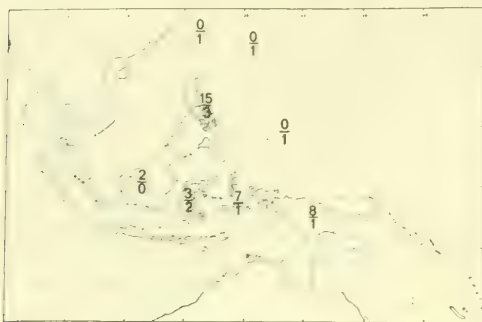


Fig. 12. Species density of *Osmoxylon* MIQ. in Malesia; above the hyphen the number of endemic species, below it the non-endemics.

branches unknown. Lateral branches c. 5 cm long, articulate near the base. Flowers 20–30, sessile on the expanded ends of the inflorescence branches. Corolla and stamens unknown. Drupes crowded, subrotund, c. 4 mm  $\varnothing$  (dry), c. 8–10 ribbed when dry, crowned by a semiglobose entire stigma, 8–10-celled. Seeds with slightly ruminant endosperm.

Distr. *Malesia*: West New Guinea. Only known from the type (coll. ZIPPELIUS).

**2. *Osmoxylon dinagatense* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 103. — *Boerlagiodendron dinagatense* MERR. Philip. J. Sc. 17 (1920) 301; MERR. En. Philip. 3 (1923) 222.

Glabrous shrub, c. 2 m. Leaves crowded at the ends of the branches; petiole 2–3 cm, channelled above, with a small triangular base, bearing a short stipular ligule (2–3 mm long) and extending around the base of the petiole as a single narrow collar; blade obovate to oblanceolate, to 23 by 8½ cm; base narrowed into the petiole, apex rounded with a very short apiculum, margin slightly revolute, entire to obscurely undulate with minute teeth, coriaceous. Inflorescence a terminal compound umbel; peduncle c. 1½ cm, with 1–few bracts (reduced leaf-bases) with small triangular bracts (3 mm long) among the primary rays; primary rays about 15, 8–10 mm long, flattened, bearing opposite bracts (2 mm long) at the apex, each bearing three branches; central branch c. 4 mm long, bearing a head of sessile, bacciform flowers c. 2½ mm  $\varnothing$ ; lateral branches 1½–2 cm long with two opposite small bracts about the middle and ending in an involucre of minute rounded bracts around a terminal umbellule of c. 7–10 flowers; pedicels 1½–2½ mm long. Calyx a minute rim. Corolla and stamens unknown. Ovary 3–4-celled. Ripe fruit unknown.

Distr. *Malesia*: Philippines (Dinagat I.).

Note. A species clearly demonstrating the congenerity of *Osmoxylon* and *Boerlagiodendron*.

**3. *Osmoxylon simplicifolium* (ELMER) PHILIPSON**, *Blumea* 23 (1976) 103. — *Boerlagiodendron simplicifolia* ELMER, Leaf. Philip. Bot. 7 (1914) 2329; MERR. En. Philip. 3 (1923) 224.

Glabrous shrub, to 5 m, with numerous leaves clustered near the ends of the branches; petiole 5–7 cm, 2 mm wide, terete, with a small clasping base, an inconspicuous stipular ligule, and a single broad disk-like crest around the lower part of the petiole; blade simple, elliptic, base broadly cuneate, apex acute to apiculate, to 20 by 6½ cm, coriaceous, margin thickened, coarsely dentate, midrib prominent, principal nerves c. 8–10 mm apart. Inflorescence a terminal compound umbel, spherical, c. 7 cm  $\varnothing$ ; peduncle 1½–2 cm; primary rays c. 25–30, c. 1 cm long with two small obtuse bracts at the apex, ending in three branches; the central branch c. 6 mm long, bearing a subglobose umbel of c. 10–12 sterile bacciform flowers (2 mm  $\varnothing$ ), 3–4 mm pedicelled; lateral branches c. 2–2½ cm long, articulated about the middle, terminating in an umbel of c. 10–20 flowers; pedicels c. 2½ mm. Calyx rim obsolete. Corolla 3–4-lobed, tubular below, 2 mm long. Stamens 3–4, exserted, 3 mm long. Ovary subcylindric, 2–4-celled, 1 mm long. Drupe spherical, c. 5 mm  $\varnothing$  (dry), 2–4-ribbed when dry; surface of endosperm shallowly wrinkled.

Distr. *Malesia*: Philippines (Mindanao: Agusan Prov., Cabadbaran).

Ecol. On wind-swept ridge at 1750 m, on moss-covered soil with stones.

Vern. *Bolauanon*, Mbo.

Note. A wide-spreading shrub. Bark thick, yellowish, becoming grey. Wood soft, yellowish. Twigs repeatedly branched, the leafy portion suberect, leaves mostly ascending, rigidly coriaceous. Inflorescence branches green. Flowers orange, odourless. Berries becoming purple-black.

**4. *Osmoxylon spathipedunculatum* (PHILIPSON) PHILIPSON**, *Blumea* 23 (1976) 103. — *Meryta spathipedunculata* PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 12.

Glabrous tree, to 20 m, with spreading branches. Leaves crowded at the ends of the branches; petiole to 14 cm with a small clasping base bearing a stipular ligule and a rim-like collar around the base of the petiole; blade obovate 17–30 by 10–15 cm, attenuate at the base, apex obtuse, margin entire, midrib prominent, secondary veins arched and uniting, 1½–2 cm apart. Inflorescence a terminal compound umbel; primary rays c. 12, stout, compressed 9–17 cm long, bearing three branches at the apex; central branches and sterile flowers unknown; the two lateral branches 9–14 cm long with an articulation c. 1–2 cm from base, bearing helmet-shaped bracts which fall to reveal the terminal head of c. 12 flowers sessile on an expanded receptacle with an involucre rim c. 1 cm  $\varnothing$ . Calyx rim 0. Corolla split into 5 lobes above, tubular below. Stamens 5. Ovary subcylindric,  $\pm$



9-celled; disk raised in the centre to the pustulate stigmas. Drupes in a spherical head, globose, c. 12 mm  $\varnothing$ , c. 9-ribbed when dry, crowned by the prominent, persistent, confluent stigmas.

Distr. Solomon Islands (Bougainville and Guadalcanal).

Ecol. Rain-forest, 800–1200 m.

**5. *Osmoxylon articulatum* PHILIPSON, Blumea 23 (1976) 103.**

Tree with stout branches, glabrous. *Leaves* well spaced towards the ends of the branches; petiole 10–13 cm, 2 mm broad, narrowly channelled above, with a small triangular base, bearing a short stipular ligule (c. 2 mm long) and extending around the base of the petiole as a collar; blade obovate, to 27 by 9 cm, base narrowly cuneate, apex rounded or acute and shortly apiculate, margin thickened, remotely dentate towards the apex, midrib prominent, principal lateral veins c.  $1\frac{1}{4}$ – $1\frac{1}{2}$  cm apart. *Inflorescence* a terminal compound umbel, almost sessile, saucer-shaped bracts caducous; primary rays c. 24, 8–11 cm long, flattened, c. 4 mm broad, bearing three branches at the apex; central branch 4–6 $\frac{1}{2}$  cm long, the apex expanded and bearing an umbel of c. 10 sterile bacciform flowers c. 6 by 6 mm (when dry) apparently 1-celled, c. 9–14 mm pedicelled; the two lateral branches c. 7 cm long at anthesis with an articulation c. 8–10 mm above the base, bearing helmet-shaped bracts which fall to reveal the terminal head of c. 15–18 flowers, sessile on an expanded receptacle with an involucre rim c. 6 mm  $\varnothing$ . *Calyx* rim 0. *Corolla* split into c. 4 lobes above, tubular below, c.  $2\frac{1}{2}$  mm long. *Stamens* 5, exserted. *Ovary* subcylindric, c.  $1\frac{1}{2}$  mm long, 7–8-celled, disk with a pustulate central stigmatic boss. *Drupes* in a spherical head c. 2 cm  $\varnothing$  (when dry), strongly 7–8-ribbed (when dry), c. 8 mm  $\varnothing$ ; stigmas persistent, prominent.

Distr. *Malesia*: Moluccas (Halmaheira: Ake Mumar to upper reaches of the Kakatua-matawe). *Fr.* Sept.

Note. This plant is evidently similar to 6. *O. umbelliferum* described by RUMPHIUS. However, a number of differences make it unlikely that it is the same species. The diameter of the inflorescence of the Halmaheira plant is only about half that given by RUMPHIUS; the lateral rays of the inflorescence are distinctly articulated near the base, a feature now shown in RUMPHIUS' figure; and the sterile bacciform flowers are long-pedicelled, whereas RUMPHIUS described and figured his as borne in the capitulum.

**6. *Osmoxylon umbelliferum* (LAMK) MERR.** Int. Rumph. (1917) 406; PHILIPSON, Blumea 23 (1976) 104. — *Pseudo-Santalum amboinense* RUMPH. Herb. Amb. 2: 54, t. 12. — *Aralia umbellifera* LAMK, Encycl. 1 (1783) 225. — *Hedera umbelliferum* (LAMK) DC. Prod. 4 (1830) 262. — *Gilibertia saurooides* DC. l.c. 256. — *Gastonia saurooides*

ROXB. [Hort. Beng. (1814) 90, *nomen*.] Fl. Ind. ed. Carey 2 (1832) 408 ('*sasurooides*'). — *O. amboinense* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 6, p.p. — *Pseudosandalum umbelliferum* (LAMK) O. K. Rev. Gen. Pl. 1 (1891) 271.

According to RUMPHIUS: Tree with stout trunk, the branches marked with prominent round leaf-scars. *Leaves* clustered at the ends of the branches, glabrous; petioles long; blades simple, lanceolate (30–36 by 10–12 cm), base rounded, apex acute, margin dentate. *Flowers* in large spreading umbels, the radiating branches tripartite, c. 30 cm long, each ending in a capitulum.

Distr. *Malesia*: Moluccas. Infrequent on Ambon, but said to be more numerous in Ceram and the Sula Islands. Only known from RUMPHIUS' excellent plate and description; not yet re-collected in Ambon.

Ecol. Evidently in forest in the hills of Ambon, and also planted at the time of RUMPHIUS.

Vern. *Sasuru*, Leytimor, *tonokuku*, Hitu.

Notes. Valued for the perfume of its wood and foliage.

Since this plant is known only from a description and a figure, some uncertainties remain as to its specific characters. In the description it is stated that the young leaves possess a few small teeth of which some signs remain on the older leaves. It is not clear whether the teeth are best developed on distinctive juvenile foliage, or whether the newly expanded normal foliage is intended. The leaves in the figure have prominent teeth, but as they are not shown associated with the inflorescence, they may be from a juvenile shoot. The description of the size of the flower buds is confusing, and it seems likely that sterile pseudo-fruits were mistaken for flower buds. Nevertheless, most characters of the plant are adequately portrayed and there can be no doubt that this species is distinct from the other simple-leaved species with a single, collar-like, petiolar crest.

**7. *Osmoxylon lanceolatum* PHILIPSON, Blumea 23 (1976) 104. — Fig. 13.**

Small tree with few branches, up to 16 m, glabrous. Many *leaves* clustered towards the ends of the branches; petiole 8–15 cm, terete, with a small triangular base, bearing a short stipular ligule (c. 2 mm long) and extending around the base of the petiole as a collar; blade oblanceolate, to 33 by 7 $\frac{1}{2}$  cm, base narrowly cuneate, apex acute or slightly apiculate, margin entire, midrib prominent, lateral veins arched ascending, c. 2–3 cm apart. *Inflorescence* a terminal compound umbel, almost sessile, saucer-shaped; bracts caducous; primary rays c. 15, c. 10 cm long, flattened, c. 4–5 mm broad, bearing three branches at the apex; central branch 5–6 cm long, the apex expanded and bearing a spherical head of c. 8–12 sessile, sterile, bacciform flowers c. 5 by 5 mm (when dry), 1–2-celled; the two lateral branches



Fig. 13. *Osmoxylon lanceolatum* PHILIPSON. Above: habit of inflorescence and leaves; below, left: twig showing collar-like crests at the base of the petioles; below, right: the trifid branches of the inflorescence (New Ireland, SANDS 795).



*c.* 5 cm long at anthesis, with an articulation immediately above the base, bearing two helmet-shaped bracts which fall to reveal the terminal head of *c.* 8–10 flowers, sessile on an expanded receptacle with an involucre rim *c.* 7 mm  $\varnothing$ . *Calyx* rim 0. Corolla known only in bud, *c.* 2½ mm long. Stamens *c.* 5. Ovary gibbous, *c.* 1½ mm high, 4-celled. Fruit unknown.

Distr. *Malesia*: New Ireland (Namatanai Subdistr., Danfu R. area, inland from Manga).

Ecol. Understorey tree in ridge top forest on limestone, 750–850 m.

Note. The bark is pale grey,  $\pm$  smooth with fine cracks. The twigs and cut branches are strongly aromatic. The wood is soft and dark straw-coloured. The central branches of the inflorescence rays are held  $\pm$  horizontally or depressed and come to maturity before the lateral branches which are held erect.

**8. *Osmoxylon oblongifolium* PHILIPSON, Blumea 23 (1976) 105.**

Shrub *c.* 2 m, glabrous when mature, setulose on young parts. *Leaves* clustered at the ends of the branches; petiole to 16 cm, channelled above, 4 mm broad, with a clasping base prolonged upwards as a stipular ligule 1½–2 cm long, and with entire or fimbriate crests encircling the lower part of the petiole; blade simple, oblong-ovate, occasionally with a small triangular lobe on each side below the middle, to 46 by 17(–24) cm, base rounded to truncate, apex shortly acuminate, margin serrate, midrib prominent, principal lateral veins *c.* 3–4 cm apart (at broadest part of leaf). *Inflorescence* a terminal compound umbel, hemispherical, *c.* 13 cm  $\varnothing$ ; peduncle 3–4 cm, *c.* 6 mm wide, bearing fimbriate, lanceolate bracts (to 2 cm long) along its length and around and among the primary rays; primary rays *c.* 20, rather short and stout (16–20 by 3–4 mm) with small opposite caducous bracts at apex, each ray ending in three branches; the central branch *c.* 4 mm long; sterile flowers unknown; the two lateral branches 3½–4 cm long, articulated below the middle, terminating in a head of *c.* 20–30 sessile or subsessile flowers. Flowers unknown. *Fruits* crowded in a spherical head, drupes *c.* 5 mm  $\varnothing$  (when dry) on pedicels *c.* 1 mm, 4-ribbed, pyrenes 4, cartilaginous; endosperm with faint reticulate ridging.

Distr. *Malesia*: Philippines (Samar).

Ecol. In dipterocarp forest, along creek bank, at 200 m.

**9. *Osmoxylon catanduanense* (MERR.) PHILIPSON, Blumea 23 (1976) 105. — *Boerlagiodendron catanduanense* MERR. Philip. J. Sc. 13 (1918) Bot. 318; En. Philip. 3 (1923) 222.**

Shrub *c.* 1 m, glabrous except for parts of the inflorescence. *Leaves* clustered at the ends of the branches; petiole *c.* 30 cm, terete, 3 mm wide, base with a short ligule, and inconspicuous

recurved crests; blade digitately compound, leaflets 7, chartaceous to subcoriaceous; petiolules 4–5 cm, the lateral shorter; leaflets lanceolate, mid-leaflet to 26 cm long, base cuneate, apex  $\pm$  caudate; irregularly lyrate lobed, the sinuses reaching to within *c.* 8 mm of the midrib, lobes 2–4 cm long, patent, margin slightly thickened, entire or obscurely dentate. *Inflorescence* a terminal compound umbel, *c.* 10 cm  $\varnothing$ , peduncle stout, bearing ovate bracts *c.* 1 mm long; primary rays *c.* 7–10, 2–2½ cm long, to 2 mm wide, minutely pubescent, with 2 broadly ovate bracts 4–5 mm long at apex; central branch 3 mm or less, bearing a head of sterile flowers; lateral branches 2½ cm long, bearing 2 broad bracts near the middle, and ending in a spherical head of *c.* 15 sessile flowers. *Calyx* an obsolete rim. Petals and stamens unknown. Ovary 4-celled. *Fruit* ovoid, 4-ridged when dry, 7 by 5 mm.

Distr. *Malesia*: Philippines (Catanduanes).

Ecol. On forested slopes, at *c.* 350 m.

Note. Together with 10. *O. caudatum* and 11. *O. heterophyllum* this species forms a small group with leaves composed of lyrate leaflets. Although the foliage is similar (though not identical), the inflorescences are distinctive. In *O. heterophyllum* the rays are short, resulting in a compact compound umbel; in *O. caudatum* there are few rays (10 or fewer); in *O. catanduanense* there are many, relatively long rays, resulting in a large, diffuse compound umbel. Since *O. catanduanense* and *O. caudatum* are known only from the type collections, the range of variation of these species is not known, but the inflorescence differences justify the retention of all three species.

**10. *Osmoxylon caudatum* (MERR.) PHILIPSON, Blumea 23 (1976) 105. — *Boerlagiodendron caudatum* MERR. Philip. J. Sc. 14 (1919) 440; En. Philip. 3 (1923) 222.**

Erect shrub, *c.* 2 m, becoming glabrous. *Leaves* clustered towards the ends of the branches; petiole *c.* 45 cm, terete, striate, 4–5 mm wide, base with a stipular ligule *c.* 1½ cm long, and 2–3 fimbriate or pectinate crests; blade digitately compound, leaflets 5–9, subcoriaceous; petiolules of the central leaflets to 5 cm long, lateral leaflets  $\pm$  sessile; leaflets elliptic-lanceolate, mid-leaflet to *c.* 25 cm long, base decurrent on the slightly winged petiole, apex caudate-acuminate, the larger leaflets with 1–3 pairs of lyrate lobes reaching almost to the midrib, lobes ascending, margin slightly revolute with often prominent usually incurved teeth. *Inflorescence* a terminal compound umbel, *c.* 18 cm  $\varnothing$ ; peduncle stout, *c.* 2 cm, bearing few ligulate bracts *c.* 1½–2 cm long, rough, with short setae on the back; primary rays *c.* 25, *c.* 4–5 cm long, glabrous and striate, subtended by ligulate bracts, similar opposite bracts at the apex, *c.* 1 cm long; central branch 1–1½ cm long, glabrous, ending in a whorl of obtuse rough coriaceous bracts



c. 3 mm long and a head (c. 1 cm  $\varnothing$ ) of sterile bacciform flowers c. 3 mm  $\varnothing$ , on pedicels 3–8 mm; lateral branches 4–5 cm long, with opposite fimbriate bracts near the middle, bearing an ellipsoid head of c. 20 sessile flowers, each flower subtended and  $\pm$  enclosed by an ovate fimbriate bract 3–4 mm long. *Calyx* an obsolete rim. Petals and stamens unknown. Ovary 2–2½ mm long, turbinate, obscurely angled, 4-celled. Fruit unknown.

Distr. *Malesia*: Philippines (Luzon: Ilocos Norte Prov., Mt Palimin).

Ecol. On forested slopes near the summit, at c. 1000 m.

Note. Apparently never re-collected. For a discussion of distinctive features see under 9. *O. catanduanense*.

**11. *Osmoxylon heterophyllum* (MERR.) PHILIPSON**, Blumea 23 (1976) 106. — *Boerlagiodendron heterophyllum* MERR. Philip. J. Sc. 9 (1914) Bot. 329; En. Philip. 3 (1923) 223.

Erect tree, c. 5 m, glabrous. *Leaves* clustered at the ends of the branches; petiole to 25 cm, base clasping, prolonged as a stipular ligule to 2½ cm long, and bearing several pectinate crests (becoming recurved when the bristles may be obscured or shed); blade to 35 cm long, digitately compound (or some leaflets imperfectly separated); leaflets 3–7, unequal in size, oblong-ovate to broadly oblong-oblancoate, acuminate, lyrate lobed and irregularly dentate, the base gradually narrowed to the petiolule; petiolule up to 7 cm. *Inflorescence* a dense terminal compound umbel; peduncle stout, c. 2 cm, bearing many lanceolate bracts 2–3 cm long; primary rays c. 30, 10–15 mm long, subtended by lanceolate c. 2½ cm long bracts, sometimes with bristles on the back, and bearing similar opposite terminal bracts 8–10 mm long, each ending in three branches; central branch short (not seen fully developed) terminating in an umbellule of c. 15 sterile bacciform flowers (c. 3 mm long), pedicels 3–4 mm; lateral branches 8–10 mm long (? fully developed), articulation present ending in heads (c. 1 cm  $\varnothing$ ) of numerous flowers. *Calyx* rim obsolete. Corolla lobes 4, 2 mm long. Stamens 4. Ovary 4-celled. Fruit unknown.

Distr. *Malesia*: Philippines (Samar, Biliran and Mindanao).

Ecol. Primary forest, under shade near creek, 100–550 m.

Vern. *Arañas*, Bis., *kayuang*, Mbo, *magusayag*, C.Bis.

Note. The description is partially based on the original publication as I have seen only immature inflorescences. For a discussion of distinctive features, see under 9. *O. catanduanense*.

**12. *Osmoxylon yatesii* (MERR.) PHILIPSON**, Blumea 23 (1976) 106. — *Boerlagiodendron yatesii* MERR.

Philip. J. Sc. 13 (1918) Bot. 44; En. Philip. 3 (1923) 225.

Shrub, 1 m, glabrous, except for the inflorescence. *Leaves* clustered towards the ends of the stout branches; petiole to 38 cm, channelled above, 5 mm  $\varnothing$ , base with a stipular ligule 1 cm long, and 1–2 inconspicuous non-fimbriate crests around the back of the petiole; blade digitately compound, leaflets 5–7; petiolule 2–7 cm (the lateral shorter); blade elliptic-oblong to ovate, mid-leaflet to 23 by 8 cm, base gradually tapered, apex acuminate-caudate, margin dentate or somewhat undulate. *Inflorescence* a terminal compound umbel, subsessile or peduncle stout 1–3 cm, bearing few ovate bracts 1 cm long; primary rays 5–10, tomentose, c. 3 cm long and 3 mm wide, subtended by ovate bracts 6 mm long, similar opposite bracts at apex; central branch 2–3 mm long, pubescent, ending in a whorl of blunt bracts (3 mm long) and an umbellule of c. 10 sterile flowers 4 mm  $\varnothing$ , 2–4-celled, pedicels 3–8 mm; lateral branches 2–2½ cm long, pubescent, with small opposite bracts about the middle, bearing a head of 10–15 sessile flowers, subtended by ovate ciliate bracts. *Calyx* rim obsolete, sometimes fimbriate. Corolla 4–5-lobed, tubular below, 1½ mm long in bud. Stamens 4–5. Ovary 4-celled. Young fruit (MERRILL, l.c.) shortly pedicelled (2–3 mm).

Distr. *Malesia*: Philippines (Luzon and Catanduanes).

Ecol. In rain-forest and mossy forest, from low altitude to 1250 m.

Vern. *Magalayag*, Dinagat.

Note. The leaves are unlike any other *Osmoxylon*, resembling those of *Macropanax* or *Schefflera*. The flowers are described as yellow, and the fruit black. The only instance of a pseudo-fruit containing apparently normal seeds occurred in this species.

**13. *Osmoxylon geelvinkianum* BECC.** *Malesia* 1 (1878) 196; PHILIPSON, Blumea 23 (1976) 106. — *Eschweilera geelvinkiana* (BECC.) BOERL. Ann. Jard. Bot. Btzig 6 (1886) 120. — *Trevesia geelvinkiana* (BECC.) O. K. Rev. Gen. Pl. 1 (1891) 272. — *Boerlagiodendron geelvinkianum* (BECC.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 32. — *Eschweilera (i) elegans* RIDL. Trans. Linn. Soc. II, 9 (1916) 63. — *Boerlagiodendron elegans* (RIDL.) HARMS, Bot. Jahrb. 56 (1920) 380. — *Boerlagiodendron stenolobum* HARMS, l.c. 382, f. 1 k–t.

Glabrous shrub with few slender branches, up to 3 m high. *Leaves* clustered near the ends of the branches; petiole up to 22 cm, usually shorter, 2–3½ mm wide, narrowly channelled above, with a sheathing base prolonged as a membranous stipular ligule up to 4 cm or longer and with fimbriate or  $\pm$  entire crests encircling the lower part of the petiole; blade up to 30 cm  $\varnothing$  (usually 20 cm or less) very deeply 5–11-lobed, or with distinct digitately arranged leaflets, the lobes or

leaflets linear-lanceolate to lanceolate-obovate, entire or irregularly pinnatifid with narrow finely-tapering lobes, base gradually narrowed, apex narrowly caudate, margin serrate; leaves below the inflorescence sometimes reduced to a single leaflet. *Inflorescence* terminal hemispherical, c. 12–20 cm  $\varnothing$ ; peduncle 1 cm or less, with caducous lanceolate bracts mostly clustered below the primary rays, 1–2 cm long; primary rays rather few, spaced, 2½–6 cm long, slender, bearing two caducous lanceolate bracts at the apex, up to 1½ cm long, each ray ending in three branches; the central branch c. 4–6 mm long bearing a whorl of lanceolate caducous bracts and an umbel of c. 7–12 sterile, globose or ovoid bacciform flowers (c. 7 mm  $\varnothing$  when dry) with pedicels c. 5 mm long and 6–9-celled; the two lateral branches c. 3–4 cm long at anthesis, articulated about the middle, terminating in a small head of 10–20 sessile or subsessile flowers. *Calyx* rim obsolete; corolla splitting into c. 4 irregular lobes above, tubular below, c. 2½ mm long. Stamens 10–14, exserted, 3 mm long, anthers small. Ovary cylindric, c. 2 mm long, 10–16-celled; disk with a central raised boss formed by the pustulate stigmas. *Fruit* globose, fleshy (ribbed when dry), c. 10 mm  $\varnothing$ .

Distr. *Malesia*: New Guinea (Irian Jaya, to Sepik and Fly R. areas).

Ecol. Primary forest, along creeks and river banks, flood-resistant, from near sea-level to 850 m.

Vern. *Amamutapu*, Kamora, *korinki*, Orne, *ida'pforporsami*, Kutubu.

Note. The narrow leaf segments, almost or quite separated at their bases, are characteristic, even though variable in outline. The flowers are described as orange or reddish, and the soft fleshy fruits as dark purple, dark blue, or black.

**14. *Osmoxylon lineare* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 106. — *Boerlagiodendron lineare* MERR. Philip. J. Sc. 3 (1908) Bot. 253; En. Philip. 3 (1923) 223.

Glabrous, erect shrub, c. 3 m. *Leaves* crowded near the ends of the branches; petiole 4–6 cm, the base with a small stipular ligule (5 mm long) and a few fimbriate crests; blade to 20 cm  $\varnothing$ , digitately compound with 4–7 leaflets (or very deeply divided into as many lobes); leaflets linear-lanceolate, c. 1–1½ cm wide, the base decurrent on the winged petiolule, apex attenuated, margin thickened, denticulate especially above. *Inflorescence* a terminal compound umbel; peduncle short (c. 1 cm), bracteate; primary rays c. 10, 2–2¾ cm long, each ending in three branches; the central branch 4–5 mm long bearing a spherical head of numerous fimbriate bracts (sterile flowers fallen); the lateral branches 3–3½ cm long with a pair of minute fimbriate bracts about the middle, ending in a capitulum of c. 20 sessile flowers subtended by small fimbriate bracts, c. 7 mm  $\varnothing$ . *Calyx* rim minute. Corolla and stamens unknown. Ovary

5-celled. Fruit ovoid c. 3 mm long, 5-ridged (when dry).

Distr. *Malesia*: Philippines (Luzon).

Note. Apparently never re-collected. The original specimen is without field information. The foliage is similar to that of 15. *O. borneense* but with shorter petioles and fewer leaflets.

**15. *Osmoxylon borneense* SEEM.** J. Bot. 6 (1868) 141; PHILIPSON, *Blumea* 23 (1976) 107. — *O. helleborinum* BECC. *Malesia* 1 (1878) 198. — *Eschweilera helleborina* (BECC.) BOERL. Ann. Jard. Bot. Btzig 6 (1887) t. 13. — *Trevesia helleborina* (BECC.) O. K. Rev. Gen. Pl. 1 (1891) 272. — *Boerlagiodendron helleborinum* (BECC.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 31. — *Boerlagiodendron borneense* (SEEM.) MERR. En. Born. (1921) 456.

Glabrous, spreading shrub, up to 3 m. *Leaves* clustered near the ends of the branches; petiole up to 24 cm, narrowly channelled above, 2–3 (or 5) mm wide, with a sheathing base prolonged as a membranous stipular ligule up to 2½ cm long, and usually with fimbriate,  $\pm$  entire, or more rarely long-setose crests encircling the lower part of the petiole; blade up to 20 cm  $\varnothing$  digitately compound (or the bases of the leaflets joined by a very short web of tissue); leaflets 9–13, linear-lanceolate to lanceolate, gradually narrowed to the base and apex, up to 20 by 3 cm, usually much narrower, margin serrate, principle veins numerous, c. 5–10 mm apart. *Inflorescence* terminal, hemispherical, c. 6–13 cm  $\varnothing$ ; peduncle 1–2 cm or shorter, with caducous lanceolate-ovate entire or fimbriate bracts mostly clustered below the primary rays, 1–1½ cm long; primary rays rather few (5–12), 2½–4 cm long, with 2 ovate bracts at the apex, c. 8 mm long, each ray ending in three branches; central branch c. 5–12 mm, bearing an umbel of c. 6–16 sterile, globose, bacciform flowers, c. 3–5 mm  $\varnothing$  (when dry) with pedicels 4–5 mm long and 5-celled; the two lateral branches 1½–3 cm long at anthesis, articulated about the middle, terminating in a small head of c. 20–25 sessile flowers with minute rounded bracts. *Calyx* rim obsolete; corolla splitting into few irregular lobes above, tubular below, c. 1½–2 mm long; stamens 5–6, slightly exserted; ovary turbinate, angled, c. 1 mm long, 5-celled, disk with a central raised boss formed by the pustulate stigmas. *Fruit* globose, fleshy (ribbed when dry) c. 5 mm  $\varnothing$ .

Distr. *Malesia*: Borneo (Sarawak, Sabah and Kalimantan).

Ecol. Characteristic of rocky river banks, not beyond flood-level, often in deep shade, from near sea-level to 950 m.

Vern. *Medong*, Kayan, *empasia abor*, Iban, *kayan*, Tamang, *koung*, Kinabalu, *bungor*, Murut Bokan, *salimpangaya*, Murut Kalabakai.

Notes. The leaves of some specimens of 13. *O. geelvinkianum* (New Guinea) resemble this



species closely. This species can be distinguished by the more compact and smaller fertile flowers, and by its leaflets being uniformly unlobed.

Both species are characteristic of river banks, and *O. borneense* has a low spreading habit, with the branches often rooting, resulting in extensive patches of this low shrub. It is a characteristic rheophyte confined to below flood-level.

The flowers are described as greenish white or cream and the inflorescence branches are frequently dark purple.

**16. *Osmoxylon pulcherrimum* VIDAL ex F.-VILL.** Nov. App. (1880) 102; Sinopsis Atlas (1883) 28, t. 55, f. B; PHILIPSON, Blumea 23 (1976) 107. — *Eschweilera pulcherrima* (VIDAL) BOERL. Ann. Jard. Bot. Btzig 6 (1887) 123. — *Trevesia pulcherrima* (VIDAL) O. K. Rev. Gen. Pl. 1 (1891) 272. — *Boerlagiodendron pulcherrimum* (VIDAL) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 32; MERR. Philip. J. Sc. 3 (1908) Bot. 254; En. Philip. 3 (1923) 224. — *Boerlagiodendron sibuyanense* ELMER, Leaflet. Philip. Bot. 7 (1914) 2328; MERR. En. Philip. 3 (1923) 224.

Erect, sparsely branched tree, up to 10 m, glabrous when mature, except for the inflorescence. Leaves crowded at the ends of the branches; petiole to 1 m, channelled above, clasping base heavily lenticellate, prolonged as a broad stipular ligule c. 2 cm long, usually with strong bristles on the back, and with strong long-pectinate crests encircling the base of the petiole; blade coriaceous, fan-shaped, c. 40 cm long, base broadly cuneate to truncate, palmately 7–11-lobed, lobes extending to within c. 12 cm from the base, lanceolate, coarsely serrate, sometimes irregularly lobulate, slightly narrowed towards the base, apex acute, sinuses rounded. Inflorescence a terminal compound umbel, c. 18 cm Ø; peduncle very short, bearing heavily setose bracts; primary rays 15–20, c. 3–4 cm long, 3–4 mm broad, setulose, at the apex bearing opposite, ovate-lanceolate bracts 10–15 mm long, each ending in three branches; central branch c. 15–20 mm long, terminating in a globular head (c. 12 mm Ø) of c. 20–30, sessile, sterile, bacciform flowers (3–4 mm Ø) 3-celled, subtended by small ovate-lanceolate bracts; lateral branches c. 5½ cm long (7½ cm in fruit), with opposite bracts (c. 3–4 mm long) near the middle, terminating in a globose head of c. 40–50 sessile flowers, bracts between the flowers very small, setulose. Calyx rim obsolete. Corolla 4-lobed, tubular below, 2 mm long in bud. Stamens 4. Ovary 4-celled. Fruit globose c. 6–8 mm long, 4-ribbed (dry).

Distr. *Malesia*: Philippines (Luzon, Mindoro and Sibuyan), recorded also from Formosa and Micronesia (Palau), cf. KANEHIRA, En. Micron. Pl. (1935) 384.

Ecol. Damp primary forests, 225–800 m.

Vern. Cf. MERRILL: *paladukai*, Bik., *salapak*, Neg.; cf. ELMER: *palad-amok*, Vis.

Notes. The fan-shaped leaves with several narrow lobes and prominent main veins resemble those of 34. *O. eminens* but are less strikingly developed. The inflorescence is considerably smaller with the pseudo-fruits forming a compact head borne on a comparatively long peduncle. The heads of true flowers, and of the fruits, are considerably smaller than those of *O. eminens*.

Although VIDAL's material is no longer available, the figure and description relate well to later collections.

The specimens on which ELMER based his *Boerlagiodendron sibuyanense* have the lobes of the leaf rather simpler in outline than is usual, but the fragments of young inflorescence are quite typical of the taxon and the name is reduced to synonymy.

**17. *Osmoxylon soelaense* PHILIPSON, Blumea 23 (1976) 108.**

A glabrous shrub or small tree. Petiole c. 32 cm, broadly channelled above, clasping base prolonged as a stipular ligule 1½ cm long, and bearing c. 3 fimbriate crests; blade c. 40 cm long, broadly cuneate at the base, palmately 7-lobed to within c. 12 cm from the base, lobes narrowly ovate to oblong-elliptic, slightly narrowed towards the rounded sinuses, apiculate, margin denticulate. Inflorescence a terminal compound umbel; peduncle c. 2 cm, bearing lanceolate bracts c. 2 cm long (similar smaller bracts subtend the primary rays); primary rays c. 1½ cm long, 5 mm wide, flattened, bearing opposite, terminal, persistent bracts 10–12 mm long, with lenticels and branched bristles on the back, ending in three branches; central branch c. 10 mm long terminating in a head 1 cm Ø of 10–15 sessile sterile bacciform flowers (4 by 3 mm when dry; 3-celled) surrounded by an involucre of ovate bracts (3 mm long) and with minute bracts interspersed; lateral branches 4½–5 cm long, bearing opposite ovate bracts (4 mm long) c. 8 mm above the base, terminating in a dense head c. 1 cm Ø of 25–30 sessile flowers interspersed with inconspicuous obtuse fimbriate bracts. Calyx rim obsolete. Corolla 5-lobed above, tubular below. Stamens 5. Ovary 4–5-celled. Fruit unknown.

Distr. *Malesia*: Moluccas (Sula Is.: Taliabu and Sulabesi).

Note. For a discussion of the distinctive features, see under 31. *O. sessiliflorum*.

**18. *Osmoxylon globulare* PHILIPSON, Blumea 23 (1976) 108.**

Shrub to 4 m, furfuraceous on the young parts. Petiole to 55 cm long, broadly channelled above, c. 1 cm wide, clasping base heavily lenticellate, prolonged as a stipular ligule 4 cm long sometimes scaly on the back, and bearing numerous irregular undulate crests on the base of the petiole often continued up the petiole, as rough fascicles of bristles as far as the blade; blade 45 cm long, base



cordate or emarginate, with some bristles underneath, palmately 7-lobed to within c. 10–15 cm from the base, lobes narrowly ovate to oblong-elliptic, slightly narrowed towards the broadly rounded sinuses, apex acute, margin serrate. *Inflorescence* a terminal compound umbel, spherical, c. 15 cm  $\varnothing$ ; peduncle stout, 2–3 cm, bracts together with those among the primary rays caducous; primary rays 30–40, rigid only slightly flattened (subterete), 2–4 cm long, 2–2½ mm wide, bearing opposite bract-scars at the apex, ending in three branches; central branch 8–10 mm long, terminating in a head c. 13 mm  $\varnothing$  of c. 20 sessile sterile bacciform flowers (5 by 4 mm when dry, 2–3-celled); pedicels to 2 mm interspersed with minute bracts; lateral branches 3–4½ cm long, with the scars of opposite bracts near the middle, terminating in a dense head 1–1½ cm  $\varnothing$  (in bud) of 20–30 sessile flowers interspersed with inconspicuous bracts. *Calyx* rim obsolete. Corolla 6–8-lobed above, tubular below, 2½ mm long (in bud). Stamens 6–8. Ovary turbinate, obscurely ribbed, 5–8-celled (varying on the same plant). Fruit unknown.

Distr. *Malesia*: Moluccas (Halmaheira, Morotai).

Ecol. In forest from sea-level to 800 m. Said to be rare in Halmaheira but common in Morotai.

Vern. *Bungan-gutu, saha-sasate*, Djailolo.

Note. For a discussion of the distinctive features see under 31. *O. sessiliflorum*.

**19. *Osmoxylon kostermansii* PHILIPSON, Blumea 23 (1976) 108.**

Glabrous, small tree, 8 m. *Leaves* clustered near the ends of the branches; petiole up to 35 cm, narrowly channelled above, c. 3 mm broad, with a sheathing base prolonged as a stipular ligule c. 2 cm long, continued around the back of the leaf-base as a single wide crest with an entire recurved margin; blade up to 30 cm  $\varnothing$ , base cordate, deeply 5–7-lobed, lobes elliptic, slightly narrowed towards the sinuses and with a short acute apiculum, margin minutely serrate and sometimes with small sub-lobes, sinuses rounded. *Inflorescence* a terminal compound umbel, hemispherical, c. 14 cm  $\varnothing$  at anthesis; peduncle c. 1 cm long, bearing small lanceolate bracts (c. 3 mm long) below and among the numerous (c. 20–24) primary rays; primary rays 4–5 cm long and 1 mm broad, with opposite bracts (2 mm long) at the apex, each ending in three branches; the central branch 5–6 mm long, bearing a spherical umbel of c. 20 small, sterile, bacciform flowers (2 mm  $\varnothing$ ) on pedicels c. 5–7 mm long, 2-celled; the two lateral branches c. 3½–4 cm long, with no articulation or bracts except for a minute involucre around the terminal umbellule of c. 10–14 flowers; pedicels c. 2–3 mm. *Calyx* rim obsolete; corolla 4-lobed, 2 mm long in bud; stamens 4; ovary subcylindric, angled, c. 1 mm long, 5–7-celled, disk with a central stylar boss.

*Fruit* spherical, c. 6 mm long, strongly ribbed when dry.

Distr. *Malesia*: Borneo (Kalimantan: Sangkulirang Distr., Mt Medadam).

Ecol. On limestone at 450 m.

Note. The foliage is similar to that of 22. *O. palmatum*, except for the distinctive petiolar crest. The inflorescence is also similar to *O. palmatum*, especially in the lack of an articulation on the rays below the umbellules.

**20. *Osmoxylon barbatum* BECC. Malesia 1 (1878) 197; PHILIPSON, Blumea 23 (1976) 109. — *Eschweilera barbata* (BECC.) BOERL. Ann. Jard. Bot. Btzig 6 (1886) 117. — *Trevesia barbata* (BECC.) O. K. Rev. Gen. Pl. 1 (1891) 272. — *Boerlagiodendron barbatum* (BECC.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 31.**

Small, glabrous tree. *Leaves* clustered near the ends of the branches; petiole to 32 cm, channelled above, 4–5 mm broad, with a sheathing base prolonged as a stipular ligule 2–3 cm long, and with several long setose crests encircling the lower part of the petiole; blade up to 43 cm  $\varnothing$ , base cordate to truncate; deeply 5–7-lobed; lobes elliptic-lanceolate, narrowed towards the sinuses and tapered to an acuminate apex, margin minutely serrate, sinuses broadly rounded. *Inflorescence* a terminal compound umbel, hemispherical, to 12 cm  $\varnothing$ ; peduncle 1–2 cm; primary rays c. 20, 3–5 cm long, with three branches at the apex; the central branch c. 1 cm long, bearing a subglobose umbel of c. 15–20, sterile, bacciform flowers (3–4 mm  $\varnothing$ ) on pedicels 5–7 mm long, 2–4-celled; the two lateral branches about 4 cm long with no clear articulation but 1 or 2 obsolescent bracts, terminating in an umbellule of c. 15–20 flowers; pedicels c. 3–4 mm. *Calyx* rim obsolete; corolla 4-lobed above, tubular below, c. 4 mm long; stamens 7 or more, rarely fewer, exserted; ovary subcylindric c. 3 mm long, angled, 7-celled; disk with a central stigmatic boss. Fruit unknown.

Distr. *Malesia*: SE. Moluccas (Key Is.).

Note. Distinguished from the closely related 22. *O. palmatum* by the long-setose petiolar crests. For discrimination from 21. *O. pfeilii* see that species.

**21. *Osmoxylon pfeilii* (WARB.) PHILIPSON, Blumea 23 (1976) 109. — *Eschweilera pfeilii* WARB. Bot. Jahrb. 13 (1891) 396. — *Boerlagiodendron pfeilii* (WARB.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 32.**

A tree developing a crown when mature, up to 16 m, glabrous when mature, young parts slightly setulose. *Leaves* in terminal clusters; petiole up to 60 cm, channelled above, c. 6 mm broad, with a sheathing base prolonged as a membranous stipular ligule 2–4 cm long, and with many pronounced, long-setose crests encircling the lower part of the petiole; blade up to 75 cm  $\varnothing$ , deeply

7–11-lobed, base cordate or emarginate; lobes lanceolate to narrowly elliptic-oblong, narrowed towards the sinuses and tapered to an attenuate apex, margin sharply and remotely serrate, sinuses broadly rounded. *Inflorescence* a terminal compound umbel, hemispherical, to 20 cm  $\varnothing$ ; peduncle short (2–3 cm); primary rays numerous (c. 30–40), 4–5 cm long, glabrous, with obsolete bracts at the apex, each ending in three branches; central branch c. 10 mm long, bearing a subglobose umbel of c. 20, small, sterile, bacciform flowers (1–1½ mm  $\varnothing$ ) on pedicels c. 3–4 mm long, 2–5-celled; the two lateral branches c. 3–4 cm long, with no clear articulation but 1 or 2 obsolescent bracts, terminating in a head of c. 12–16 subsessile flowers (pedicel c. 1 mm, becoming longer in fruit) surrounded by an inconspicuous involucre. *Calyx* rim obsolete; corolla 5-lobed, 1½ mm long in bud; stamens 5; ovary subcylindric, angled, 1½ mm long at anthesis, 5–16-celled, disk with a central boss formed by the united pustulate stigmas. *Fruit* spherical, fleshy, c. 8 mm  $\varnothing$ , ribbed when dry, the stigmatic boss persistent and prominent; pyrenes cartilaginous.

*Distr. Malesia:* Bismarck Archipelago (New Britain, Duke of York Group and New Ireland).

*Ecol.* Primary rain-forest, from near sea-level to 600 m.

*Vern. Sare, sasare, sare a lauvolau*, New Britain, Pomio; *a ibalur*, New Ireland.

*Notes.* The bark is grey-brown and pustular, the wood straw-coloured and soft. The flowers are orange, and the ripe fruit dark red-violet.

In the original description the ovary is recorded to possess 10–14 cells. However, some other specimens have as few as 5 cells in the ovary, but in other respects agree with specimens with the large number of seeds. Since the inflorescence, leaf-shape, and especially the nature of the petiolar crests, as well as the distribution, are all highly distinctive within the genus, all the specimens can be accepted as examples of one species with a highly variable number of carpels.

This species is very close to 20. *O. barbatum* of the Key Islands. The original diagnostic character of the number of cells in the ovary has been found to be unreliable. However, since the primary rays in the inflorescence are more numerous and the pedicels of the fertile and sterile flowers are shorter this geographically distinct species is maintained.

**22. *Osmoxylon palmatum* (LAMK) PHILIPSON, comb. nov.** — *Folium polypti mas (et femina?)* RUMPH. Herb. Amb. 4: 101, t. 43. — *Aralia palmata* LAMK, Encycl. 1 (1783) 224, type, non LOUR. 1790, nec R. & S. 1820. — *Trevesia moluccana* MIQ. Fl. Ind. Bat. 1, 1 (1856) 748; Bonplandia 4 (1856) 137. — *Trevesia zippeliana* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 11. — *Unjala bifida* REINW. ex DE VRIESE, Pl. Ind. Or. (1867) 83, *nomen in synon.*; ex BOERL. Ann. Jard. Bot. Btzig 6 (1887) 166, in

*synon.* — *O. moluccanum* (MIQ.) BECC. Malesia 1 (1878) 195; PHILIPSON, Blumea 23 (1976) 109. — *O. zippelianum* (MIQ.) BECC. Malesia 1 (1878) 195. — *Eschweilera palmata* ZIPP. ex BOERL. Ann. Jard. Bot. Btzig 6 (1887) 116, t. 14. — *Boerlagiodendron palmatum* (ZIPP. ex BOERL.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 31; MERR. Int. Rumph. (1917) 407. — *Boerlagiodendron moluccanum* (MIQ.) BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 3; Blumea 6 (1950) 367; BACK. & BAKH. f. Fl. Java 2 (1965) 163.

Small, glabrous tree to 15 m. *Leaves* clustered near the ends of the branches; petiole up to 40 cm, channelled above, 4–5 mm broad, with a sheathing base prolonged as a stipular ligule up to 5 cm long, and with several fimbriate crests encircling the lower part of the petiole; blade up to 45 cm  $\varnothing$ , base cordate, deeply 5–9-lobed, lobes elliptic, slightly narrower towards the sinuses, acuminate, margin serrate and sometimes with small sub-lobes, sinuses rounded. *Inflorescence* a terminal, compound umbel, subspherical, to c. 20 cm  $\varnothing$  at anthesis; peduncle c. 1–2 cm, with small caducous bracts below and among the numerous (20–60) primary rays; primary rays 3–5 cm long, 2–3 mm broad, each ending in three branches; central branch 6–10 mm long, bearing a spherical umbel of c. 20–30 small, sterile, bacciform, flowers (2–4 mm  $\varnothing$ ) on pedicels 4–6 mm long, 4–7-celled; two lateral branches c. 2½–5 cm long, rigid and straight, with no articulation (indistinct scars of bracts may occur below the involucre), bearing a minute involucre around the terminal umbellule of c. 12–20 flowers; pedicels to c. 5 mm (occasionally flowers subsessile). *Calyx* rim obsolete. Corolla irregularly 4–5-lobed above, tubular below, c. 5 mm long. Stamens 6–9, exserted, filaments stout. Ovary subcylindric, angled, c. 2 mm long, 6–9-celled, disk with a raised central stigmatic boss. *Fruit* globose, fleshy, c. 10 mm  $\varnothing$ , strongly ribbed when dry.

*Distr. Malesia:* Celebes (once, not localized) and Moluccas (Buru, Ceram, Ambon, Banda, Tenimber Is.).

Also cultivated in the Bogor Botanic Garden.

*Ecol.* An understory tree in primary rain-forest.

*Uses.* The leaves are used for culinary and medicinal purposes (against gonorrhoea).

*Vern. Daun gurita, pelenda darat, saha-saha*, Moluccas, *fumala-alas*, Tenimber Is.

*Note.* The spherical inflorescence is characteristic, having straight rigid rays with no articulation on the secondary branches, and the pseudo-fruits are well separated from the true flowers. MIQUEL distinguished *Trevesia zippeliana* because the collector noted that its ovary was 4-celled. Possibly this number related to the sterile flowers. In two gatherings from Ambon (Waii, TEYSMANN; G. Salhutu, BOERLAGE 179) the fertile flowers are



subsessile in heads, but otherwise conform to the characters of this species. The only record of this genus from the Tenimber Is. consists of leaves only, but their characters conform to this species.

**23. *Osmoxylon ramosii* (MERR.) PHILIPSON, Blumea 23 (1976) 110. — *Boerlagiodendron ramosii* MERR. Philip. J. Sc. 11 (1916) Bot. 27; MERR. En. Philip. 3 (1923) 224.**

Erect, unbranched, or sparingly branched, 4 m high shrub, becoming glabrous. *Petiole* to 40 cm, the clasping base prolonged as a stipular ligule *c.* 2 cm long, and with few to several prominent recurved, obscurely fimbriate, crests surrounding the lower part of the petiole; blade to 30 cm long, base emarginate, palmately 3–7-lobed, lobes extending to within 3–8 cm from the base, oblong-ovate, margin serrate, sometimes lyrate lobulate, apex acuminate, sinuses broadly rounded. *Inflorescence* a terminal compound umbel, 10–15 cm  $\varnothing$ ; peduncle stout, with lanceolate bristle-bearing bracts; primary rays *c.* 15, 2–3 cm long, 2–3 mm wide, flattened, subtended by lanceolate bracts *c.* 2 cm long, with bristles on the back and bearing similar opposite terminal bracts *c.* 1 cm long, each terminating in three branches; central branch *c.* 4 mm long, slightly pubescent, terminating in an umbellule (*c.*  $1\frac{1}{2}$  cm  $\varnothing$ ) of *c.* 10–15 sterile, bacciform flowers 4–5 mm  $\varnothing$ , 2-celled, pedicels 5–8 mm long, subtended by caducous bracts; lateral branches  $2\frac{1}{2}$  cm long (slightly longer as fruits

form), without any articulation or bracts except for a caducous small involucre around the terminal head of *c.* 25–35 sessile or very short-pedicelled flowers, *c.* 1 cm  $\varnothing$ , bracts among the flowers obscure. *Calyx* rim obsolete. Corolla 4-lobed above, tubular below. Stamens 4, exerted, filaments broad. Ovary subcylindric, obscurely angled, 4-celled. Fruit spherical 9 mm  $\varnothing$ , 4-ribbed when dry.

Distr. *Malesia*: Philippines (Luzon).

Ecol. On low-lying, wet ground, in forest, or on forested slopes, 700–800 m.

Notes. The flat-topped inflorescence is *c.* 15 cm  $\varnothing$  with much-reduced leaves below it. The inflorescence rays are dark purplish and the flowers orange-yellow. The bark is grey and the wood soft.

This is the only species in the Philippines without opposite bracts on the lateral branches of the inflorescence rays. In this respect it resembles *22. O. palmatum* and a few other species.

**24. *Osmoxylon novoguineense* (SCHEFF.) BECC. Malesia 1 (1878) 197; PHILIPSON, Blumea 23 (1976) 110. — *Trevesia novo-guineensis* SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 26. — *Eschweilera novoguineensis* (SCHEFF.) BOERL. *ibid.* 6 (1886) 118. — *Boerlagiodendron novoguineense* (SCHEFF.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 31; BACK. & BAKH. f. Fl. Java 2 (1965) 163. — *Boerlagiodendron lauterbachii* HARMS in K. Sch. & Laut. Fl. Schutzgeb. (1900) 484. — Fig. 11, 14.**



Fig. 14. *Osmoxylon novoguineense* (SCHEFF.) BECC. Petiolar base with ligule and collar-like crests (Photogr. PHILIPSON, Wantoat, 1968).



Tree or shrub, unbranched or sparingly branched, up to 16 m, the young parts rufous-furfuraceous, glabrescent. Large leaves forming terminal crowns; petiole up to 1 m, stout (1–2 cm broad), flattened above, with a sheathing base prolonged as a strong stipular ligule up to 7 cm long, and with fimbriate crests encircling the lower part of the petiole; blade up to 1.20 m  $\varnothing$ , with 5–7 strong ribs radiating from the top of the petiole, deeply lobed almost to the base of these ribs, the lobes in turn deeply lobed and incised, the central lobes especially being strongly pinnatisect or digitately tripartite, apices acute, margins serrate; upper leaves associated with inflorescences may be smaller, more simply lobed, or entire. *Inflorescence* terminal, a large compound umbel, bowl-shaped, up to 35 cm  $\varnothing$ ; peduncle up to 10 cm, stout, with lanceolate caducous bracts (c. 4 cm long) below and among the numerous (c. 50–70) primary rays; primary rays c. 12–15 cm long at anthesis, c. 3 mm  $\varnothing$ , bearing two caducous bracts (1 cm long) at the apex, each ray ending in three branches; central branch c. 2 cm long, bearing an umbel of c. 20–40, sterile, bacciform flowers (c. 6 mm  $\varnothing$  when dry) on pedicels c. 10 mm, and 2–6-celled; the two lateral branches c. 4–6 cm, with two opposite or sub-opposite bracts about the middle, terminating in a subspherical umbel  $2\frac{1}{2}$ –3 cm  $\varnothing$  of 30–50 flowers on pedicels c. 8–10 mm long. *Calyx* rim obsolete, undulate. Petals with irregular erect lobes, tubular below. Stamens 6–10 exserted. Ovary turbinate somewhat angled; glabrous, 6–14-celled; disk flat with a central double row of pustulate stigmas. *Fruits* on stiff radiating pedicels, ovoid or spherical, fleshy, ribbed when dry.

Distr. Solomon Is.; in *Malesia*: throughout New Guinea and in the Bismarck Archipelago.

Ecol. Primary and second-growth forest, from sea-level to 1600 m.

Vern. *Lebe*, *Mooi*, *teresakui*, *Manikiong*, *akriek*, *Biak*, *hoppung*, *Hottam*, *uger*, *Wagu*, *faliifalii*, *Tifal*, *ap gan dandam*, *aimaini*, *Mamig*, *ida'pfoforsami*, *Kutubu*, *pulaka*, *Gazelle Peninsula*.

Notes. The foliage is similar to that of *O. boerlagei*, but the pedicelled flowers of *O. novoguineense* distinguish it readily from that species. The ripe fruits are usually ovoid, but in the Solomon Is. they are characteristically spheroidal, and this feature recurs in some specimens from the Bismarck Archipelago and the adjacent coast of New Guinea.

The fawn bark is pustulate with many lenticels. An orange exudate flows from the cut stems. The wood is soft and straw-coloured. The inflorescence branches are dark purple, the corolla and stamens usually deep red, and the ripe fruit shining purple or blue-black.

**25. *Osmoxylon teysmannii* (BOERL.) PHILIPSON**, *Blumea* 23 (1976) 111. — *Eschweilleria teysmannii* BOERL. *Ann. Jard. Bot. Btzg* 6 (1887) 119. —

*Trevesia teysmannii* (BOERL.) O. K. *Rev. Gen. Pl.* 1 (1891) 272. — *Boerlagiodendron teysmannii* (BOERL.) HARMS in E. & P. *Nat. Pfl. Fam.* 3, 8 (1894) 31.

A small, glabrous tree, 6 m. *Leaves* clustered at the ends of the branches; petiole to 40 cm, channelled above, 4 mm broad, with a sheathing base prolonged as a stipular ligule  $2-2\frac{1}{2}$  cm long, and with several fimbriate or entire crests on the lower part of the petiole; blade c. 30 cm  $\varnothing$ , membranous, cordate at the base, deeply 7-lobed, lobes elliptic, slightly narrowed to the broadly rounded sinuses, narrowed to a fine apiculum at the apex, margin finely serrulate. *Inflorescence* a terminal compound umbel, c. 10 cm  $\varnothing$ ; peduncle c. 1 cm, bearing ovate bracts (ligules of reduced leaves) and terminating in a cluster of bracts (c. 10 mm long) below and among the primary rays; primary rays c. 12–15, c. 3–4 cm long, with a pair of lanceolate bracts at the apex (c. 1 cm long); central branch c. 1 cm long, terminating in an umbellule of c. 5–8 sterile bacciform flowers (c. 4 mm  $\varnothing$  when dry) on pedicels 6–9 mm long interspersed with linear bracts 5 mm long; two lateral branches c.  $3\frac{1}{2}$  cm long, articulated about the middle, terminating in an umbellule surrounded by caducous linear bracts (leaving a rim-like involucre); flowers c. 8–12, pedicels c. 2–3 mm. *Calyx* rim obsolete. Corolla 3 mm long, with 7–8 lobes above, tubular below. Stamens 7–8, filaments stout, anthers exserted. Ovary sub-cylindric, angled, c.  $1\frac{1}{2}$  mm long, 7–8-celled; disk flat, with a central stigmatic boss. Fruit unknown.

Distr. *Malesia*: SW. Celebes (Tjamba, Kosali-Porema) and NW. Central Celebes (Palu-Parigi and Mt Nokilalaki).

Ecol. In rain-forest, 800–1000 m.

**26. *Osmoxylon humile* (ELMER) PHILIPSON**, *Blumea* 23 (1976) 111. — *Boerlagiodendron humilis* ELMER, *Leaf. Philip. Bot.* 7 (1914) 2327; MERR. *En. Philip.* 3 (1923) 223.

Erect, small, sparsely branched shrub, up to  $1\frac{1}{2}$  m. *Leaves* clustered at the ends of the branches; petiole to 25 cm, terete, base prolonged as a stipular ligule c. 1 cm long, and with c. 3 entire crests at the base; blade palmately 5-lobed, 24 cm long, base truncate or cordate, lobes reaching to within 3–6 cm from the base, elliptic, 4–6 cm wide, narrowed towards the broadly rounded sinuses, tapered to an acute apiculum, margin serrate in the upper part, the outer lobes with a lobule on the lower edge. *Inflorescence* a terminal compound umbel, 9 cm  $\varnothing$ , subtended by a few foliaceous bracts; peduncle stout, 2–3 cm, with furfuraceous, oblong bracts; primary branches crowded, numerous,  $2\frac{1}{2}$  cm, furfuraceous, flattened, striate with opposite minute bracts at the apex; central branch c. 3 mm, bearing an umbellule of sterile, bacciform flowers  $3\frac{1}{2}$  mm  $\varnothing$ , pedicels  $4\frac{1}{2}$  mm; lateral branches 3– $3\frac{1}{2}$  cm, articulated about the middle, terminating in an umbellule of c. 15 flowers, bracts

inconspicuous, fimbriate, pedicels  $1\frac{1}{2}$ –2 mm. *Calyx* an obsolete rim. Corolla and stamens not known. Ovary  $1\frac{1}{2}$ –2 mm, 4-celled, with a flat disk and a raised central stigmatic boss, 4-celled. *Fruit* 6 by 4 mm (dry) 4-ribbed; pyrenes crustaceous; endosperm rugose.

Distr. *Malesia*: Philippines (Mindanao).

Ecol. Damp fertile ground in dense forest, on south side of Baruring R., at 1000 m.

Vern. *Sarang-ka-máno*, Bag.

**27. *Osmoxylon pectinatum* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 111. — *Boerlagiodendron pectinatum* MERR. Philip. J. Sc. 3 (1908) Bot. 253, 424; En. Philip. 3 (1923) 224; KANEHIRA, Form. Trees rev. ed. (1936) 520, f. 480; HUI-LIN LI, Woody Fl. Taiwan (1963) 666, f. 273.

Shrub or small glabrous tree up to 8 m. *Leaves* clustered at the ends of the branches; petiole to 18 cm, with a clasping base prolonged as a short acute stipular ligule, and with several basal crests fringed with 1–2 cm long bristles; blade to 25 cm  $\varnothing$ , base truncate to broadly cuneate, palmately 5–7-lobed, lobes reaching to about the middle of the lamina, sinuses narrow-rounded, lobes oblong-elliptic, usually slightly narrowed below, obtuse to acute, margin thickened, coarsely dentate, coriaceous. *Inflorescence* a terminal compound umbel; peduncle c. 1 cm, with small bracts (3 mm) below and among the primary rays; primary rays c. 25–35, c. 2–3 cm long, with opposite ovate caducous bracts at the apex, each terminating in three branches; central branch c. 8–11 mm long, ending in an involucre of minute bracts (1 mm) surrounding an umbellule of c. 15–20 ovoid sterile flowers (c. 3 mm long, 3-celled), pedicels 5–6 mm long; lateral branches c.  $2\frac{1}{2}$  cm long at anthesis, with an articulation about the middle, ending in an umbellule c. 1 cm  $\varnothing$  with minute fimbriate bracts; flowers c. 30, pedicels c.  $1\frac{1}{2}$  mm (elongating slightly in fruit). *Calyx* rim obsolete. Corolla lobes 4–5, tubular below, 2 mm long. Stamens 4–5. Ovary turbinate,  $1\frac{1}{2}$  mm long, 4–6-celled. *Fruits* globose, 5 by 5 mm (dry), 4–6-ribbed when dry.

Distr. Taiwan (Botel Tobago and Lutao I., east off Taiwan proper); in *Malesia*: N. Philippines (Batan I.).

Ecol. Forested slopes at 650 m.

Vern. *Narapan*, Iv.

**28. *Osmoxylon masarangense* PHILIPSON**, *Blumea* 23 (1976) 111.

Small tree, 5 m, the young parts setulose, becoming  $\pm$  glabrous. *Leaves* in terminal clusters; petiole c. 17 cm, rather narrow ( $1\frac{1}{2}$ –2 mm  $\varnothing$ ), channelled above, with a small clasping base, prolonged as a stipular ligule, 1– $1\frac{1}{2}$  cm long, setulose on the back, and with a number of long-setulose crests encircling the lower part of the petiole; blade c. 18 by 22 cm, deeply 3–5-lobed (or below the inflorescence sometimes simple), the

base truncate or emarginate, lobes oblong or elliptic, slightly narrowed to the broadly rounded sinuses, apex with a short apiculum, membranous, margin finely setulose-serrate, sinuses c. 6 cm from base of the blade. *Inflorescence* a terminal sessile compound umbel; primary rays c. 10, setulose,  $1\frac{3}{4}$ –2 cm long, each ray ending in three branches; central branch 4–5 mm long, ending in an umbellule, pedicels 6 mm, sterile flowers not known; two lateral branches 2– $2\frac{1}{2}$  cm long, 1 mm broad, with two bract scars about the middle but usually not opposite, terminating in an umbellule with c. 10 pedicels 3–5 mm long (in fruit). Flowers unknown. *Fruit* (when dry) ovoid, 6 by 4 mm, 5-seeded.

Distr. *Malesia*: N. Celebes (Minahasa, Tomohon, Mt Masarang).

Ecol. Secondary forest at edge of crater lake, at 1200 m.

Note. This species is similar in aspect to the Philippine 39. *O. trilobatum*, but the petiolar crests are distinctive.

**29. *Osmoxylon insidiator* BECC.** *Malesia* 1 (1878) 195; PHILIPSON, *Blumea* 23 (1976) 112. — *O. carpophagum* BECC. *Malesia* 1 (1878) 196. — *Eschweilera insidiatrix* (BECC.) BOERL. Ann. Jard. Bot. Btzig 6 (1886) 120. — *Eschweilera carpophagum* (BECC.) BOERL. l.c. 121, t. 15. — *Trevesia insidiator* (BECC.) O. K. Rev. Gen. Pl. 1 (1891) 272. — *Trevesia carpophagum* (BECC.) O. K. l.c. — *Boerlagiodendron insidiator* (BECC.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 32. — *Boerlagiodendron carpophagum* (BECC.) HARMS, l.c. — *Boerlagiodendron pachycephalum* HARMS, Nova Guinea 8 (1910) 271.

Small tree to 12 m, young parts with uniform scurfy tomentum. Large *leaves* forming terminal crowns; petiole up to 80 cm, stout (1–2 cm  $\varnothing$ ), broadly channelled above, with a sheathing base prolonged as a strong stipular ligule c. 9 cm long, and with moderately developed irregular (not fimbriate) crests encircling the lower part of the petiole; blade up to 85 cm  $\varnothing$ , with 5–7 strong ribs radiating from the top of the petiole, deeply lobed almost to the base of these ribs, lobes in turn deeply lobed and incised, the median often digitately tripartite, apices long acuminate, margin irregularly and remotely serrate, subglabrous when mature or showing remnants of the tomentum. *Inflorescence* a terminal hemispherical compound umbel, c. 15 cm high by 30 cm wide; peduncle short, stout ( $1\frac{1}{2}$ –2 cm  $\varnothing$ ), with lanceolate bracts 4–6 cm long below and among the numerous (15–20) primary rays; primary rays 6–10 cm long, c. 5–12 mm wide, rigid, bearing 2 lanceolate bracts (2–3 cm long) at the apex, each ray ending in three branches; central branch c.  $1\frac{1}{2}$  cm long, bearing an umbel of c. 30 sterile bacciform flowers (c. 5–12 mm  $\varnothing$  when dry), the pseudo-fruits and their pedicels  $\pm$  rufous tomentose, pedicels 10–12 mm,



and 6-celled, surrounded by an involucre of short ovate bracts (3–8 mm long); two lateral branches c. 6 cm at anthesis, rigid, slightly flattened, to 8 mm broad, bearing a pair of bracts (c. 1½ cm long) about the middle, terminating in a subglobose head 3½–4 cm Ø of c. 30–40 sessile flowers, and surrounded by an involucre of ovate bracts c. 10–14 mm long. *Calyx* rim fimbriate. Petals irregularly 4–5-lobed, 7–8 mm long, connate below to form a fleshy tube, pubescent on the outer surface. Stamens c. 15–26, filaments strap-like, projecting beyond the corolla, anthers c. 4 mm long. Ovary shortly turbinate, 2–4 mm long, angled, furfuraceous, c. 13–25-celled; disk flat, with a central boss formed of the pustulate stigmas. *Fruits* in a compact spherical head, the individual drupes angled by mutual pressure, and bearing the persistent stigmas on the exposed face, c. 10–14 mm long, the numerous pyrenes compressed and flat; cartilaginous.

*Distr. Malesia:* throughout New Guinea, but local; also Waigeo I.

*Ecol.* Primary rain-forest and regrowths, frequently beside streams, from sea-level to 350 m.

*Vern.* *Angit*, *kangit*, Waigeo, *pennifogo*, Orakawa, Papua.

*Notes.* The bark is greyish brown, slightly fissured with many lenticels. The wood is soft and

white. The flowers are reddish-brown or purple, with orange-red filaments and the fruit purple.

BECCARI provided a detailed description of the living plant, and noted that the fruits are eaten by various species of pigeon.

*Boerlagiodendron pachycephalum* HARMS has very strongly developed umbels and leaves, but apart from size, it does not differ from this species. Since a range in stature is shown by the several gatherings now available, the whole is best regarded as a single species.

Similarly, the very short pedicels of *O. carpopagharum*, which BECCARI used to distinguish it from *O. insidiator*, can in fact be matched on several specimens of that species.

30. *Osmoxylon boerlagei* (WARB.) PHILIPSON, *Blumea* 23 (1976) 112. — *Eschweilera boerlagei* WARB. *Bot. Jahrb.* 13 (1891) 395. — *Boerlagiodendron warburgii* HARMS in E. & P. *Nat. Pfl. Fam.* 3, 8 (1894) 32, *nom. illeg. superfl.*; in K. Sch. & Laut. *Fl. Schutzgeb.* (1900) 484. — *Boerlagiodendron boerlagei* (WARB.) HARMS, *Bot. Jahrb.* 56 (1920) 382. — **Fig. 15.**

Small to fairly large tree, unbranched or sparingly branched, up to 24 m, glabrous, at least when mature. Large leaves forming terminal crowns; petiole up to 1 m, stout (1–2 cm Ø),



Fig. 15. *Osmoxylon boerlagei* (WARB.) PHILIPSON. Showing that each ray ends into a central umbel of bacciform flowers and two lateral umbels with normal flowers (Photogr. PHILIPSON, Kassam Pass, E. New Guinea, 1968).



broadly channelled above, with a sheathing, heavily lenticellate base prolonged as a strong stipular ligule up to 7 cm long, and with lacerate crests encircling the lower part of the petiole; blade up to 1.15 m  $\varnothing$ , with 5–7 strong ribs radiating from the top of the petiole, deeply lobed almost to the base of these ribs, lobes in turn deeply lobed and incised, the central lobes especially being strongly pinnatisect or digitately tripartite, apices acute, margin undulate or indistinctly serrate. *Inflorescence* terminal (or overtopped by a lateral leafy branch), a large compound umbel, bowl-shaped with a slightly convex top, up to 60 cm  $\varnothing$ ; peduncle c. 10 cm, stout, with lanceolate bracts below and among the very numerous radiating primary rays; outer primary rays c. 20 cm long at anthesis (elongating in fruit), inner rather shorter, woody, bearing two caducous bracts at the apex, each ray ending in three branches; central branch c. 4 cm, bearing an umbel of c. 20 sterile bacciform flowers (c. 8 mm  $\varnothing$  when dry) with rigid pedicels c. 1½ cm long, and 5–6-celled; two lateral branches c. 9 cm long at anthesis, articulated about the middle, terminating in a button-like head of c. 20–30 sessile flowers and surrounded by ovate bracts which soon fall leaving a bowl-shaped involucre, c. 1½ cm  $\varnothing$ . *Calyx* rim obsolete. *Petals* c. 13, bud flat-topped, angled, minutely pubescent, apparently falling as a calyptra. *Stamens* 8–13. *Ovary* shortly turbinate, angled, glabrous, 10–14-celled; disk flat, with a central double row (or ellipse) of pustulate stigmas. *Fruits* spreading to form a  $\pm$  spherical head obscuring the involucre, each c. 9 by 7 mm (when dry) with prominent persistent stigmas.

*Distr. Malesia:* throughout New Guinea.

*Ecol.* Primary forest, and secondary growths on old cultivations, from near sea-level to 1800 m.

*Vern.* *Eunya*, *Gimi*, *apiatambay*, *Washkuk*, *ma-korr-korr*, *Jal*, *teresahui*, *Manikiong*.

*Note.* Bark yellow grey with shallow fissures and many pale corky pustules; wood straw-coloured, fibrous. The large terminal inflorescence is shallowly convex on top and is surrounded by several large leaves. Flowers reddish brown. Fruit purplish black and succulent.

**31. *Osmoxylon sessiliflorum* (LAUT.) PHILIPSON**, *Blumea* 23 (1976) 113. — *Boerlagiodendron sessiliflorum* LAUT. *Nova Guinea* 8 (1910) 272.

Small tree, up to 18 m, glabrous when mature, or tomentum persistent on the inflorescence. *Leaves* crowded at the ends of the branches; petiole to 60 cm, with the clasping base prolonged as a stipular ligule up to 6 cm long, and with few to several strong or weak crests around the base of the petiole, margin undulate or fimbriate; blade to 50 cm long, base cordate, palmately 5–9-lobed, lobes extending to near the base, elliptic, coarsely serrate, often irregularly lobulate, apex acute, sinuses rounded. *Inflorescence* a terminal compound umbel;

peduncle to c. 4 cm, bearing lanceolate bracts to 2½ cm long, caducous or persistent, occasionally with some bristles on the back, primary rays c. 20–30, c. 9 cm long,  $\pm$  pubescent, bearing opposite caducous or rarely persistent bracts at the apex; central branch variable in length (2–18 mm), bearing an umbellule or head 1–2½ cm  $\varnothing$  of sterile bacciform flowers (4–5 mm  $\varnothing$ ), 4–8-celled, subtended by minute bracts, pedicels variable in length (5–18 mm); lateral branches 3–7 cm, articulated near the middle, terminating in a globose head of c. 20–30 sessile flowers (or pedicels 1½ mm long), bracts between the flowers very small. *Calyx* rim obsolete. *Corolla* few- to many-lobed, tubular below, 1½–4 mm long in bud. *Stamens* 6–17. *Ovary* 5–18-celled. *Fruit* a globose head of drupes; drupes c. 10 by 6 mm, obovoid, ribbed when dry.

*Distr. Malesia:* throughout New Guinea.

*Ecol.* Rain-forest, especially along the muddy banks of rivers, from sea-level to 100 m.

*Vern.* *Akriek*, *Biak*, *korinki*, *Orne*, *kwita-kwita*, *Milne Bay*, *sapi-ai*, *Jense*, *terrasahui*, *Manikiong*.

*Notes.* Unbranched or sparsely branched with crowns of large leaves. The bark is light brown and the wood cream. The inflorescence branches are purple, the flowers red, and the succulent ripe fruits black.

The variation in the numbers of floral parts is considerable. Most specimens have more than 10 stamens and the same number of cells in the ovary, or more. Three gatherings have from 5–7 stamens and cells. These may possibly require to be segregated as a distinct species, but other evidence to support this course is lacking. An even more distinctive gathering has central branches to 3 cm long with the pseudo-fruits on short pedicels (less than 5 mm) and flowers with 17 stamens and 25 cells in the ovary. These characters have not been included in the specific description as this specimen is only very tentatively referred to this species.

This species forms an eastward extension of a complex of species, represented in the Moluccas by 37. *O. talaudense*, 17. *O. soelaense* and 18. *O. globulare*. Several similar species occur in the Philippines. They are characterized by dense spherical heads of flowers.

*Osmoxylon talaudense* resembles some specimens of *O. sessiliflorum* rather closely, and the difficulty of preserving the characters of these large-leaved plants in an herbarium probably obscures several good diagnostic features. The most reliable character to distinguish these two species is the position of the articulation on the lateral branches of the inflorescence rays. In specimens from the Talaud Is. this is close to the base (below the apex of the central umbellule of pseudo-fruits) and the bracts are persistent, whereas in the New Guinea material it is near (or above) the middle, and is usually marked by two inconspicuous scars which frequently are not opposite. In both species the pseudo-fruits are pedicelled, whereas in the other

two Moluccan species the pseudo-fruits are sessile or subsessile forming spherical heads. In *O. globulare* (from Morotai and Halmahera) the lateral branches are rigid and only slightly flattened with the articulation near the middle and the bracts caducous. In *O. soelaense* the articulation is much nearer the base, the bracts are persistent, and the branches are broader and much flattened.

**32. *Osmoxylon camiguinense* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 113. — *Boerlagiodendron camiguinense* MERR. Philip. J. Sc. 3 (1908) Bot. 252; En. Philip. 3 (1923) 222.

Shrub to 2 m, glabrous except for the inflorescence. *Leaves* clustered at the ends of the branches; petiole to 18 cm, with a sheathing base prolonged as a stipular ligule 1 cm long, and with several entire crests encircling the lower part of the petiole; blade 20 by 22 cm, base truncate, 3–5-lobed to about the middle, lobes oblong, scarcely narrowed towards the base, apex acuminate, sinuses broad, rounded, margin dentate, coriaceous. *Inflorescence* a terminal compound umbel; primary rays c. 2–2½ cm, pubescent with opposite lanceolate bracts (c. 12 mm long) at the apex; central branch c. 4 mm long, bearing a globose umbellule (c. 12 mm Ø) of sterile bacciform flowers (c. 2 mm Ø), pedicels c. 3 mm, subtended by numerous ligulate bracts; lateral branches c. 3 cm long, with opposite lanceolate bracts 4 mm long, ending in a head of c. 20–30 sessile flowers. Corolla and stamens not seen, described by MERRILL as 3-merous. *Fruit* globose 6 mm Ø (dry), 3-seeded.

*Distr. Malesia*: Philippines (Babuyan Is.: Camiguin I.).

*Ecol.* On slopes in forest, at 500 m.

**33. *Osmoxylon fenicis* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 114. — *Boerlagiodendron fenicis* MERR. Philip. J. Sc. 13 (1918) Bot. 44; En. Philip. 3 (1923) 223. — *Boerlagiodendron tayabense* MERR. Philip. J. Sc. 13 (1918) Bot. 45; En. Philip. 3 (1923) 224.

Erect shrub or treelet a few m high, glabrous except for the inflorescence. *Petiole* to 45 cm, clasping base prolonged as a broad stipular ligule, 1½–3 cm long, several prominent long pectinate petiolar crests extending up the petiole as oblique groups of bristles; blade to 30 cm long, base cordate or truncate, deeply palmately 3–7-lobed, lobes extending to within c. 7 cm of the base, broadly elliptic to oblong, entire or with subsidiary lobes, somewhat narrowed towards the sinuses, apex abruptly apiculate, margin remotely denticulate or serrate, sinuses very broadly rounded. *Inflorescence* a terminal, compound, furfuraceous umbel, hemispherical, c. 10–12 cm Ø; peduncle 2–3 cm, densely enclosed in broadly ovate bracts c. 2 cm long, bearing dense fascicles of strong bristles on their blades; primary rays 15–30, c. 2½–3 cm long, 2½ mm wide, pubescent, subtended by large bristly bracts c. 1½ cm long,

bearing opposite terminal usually bristly bracts 6–15 mm long, each ending in 3 branches; central branch c. 4–10 mm, pubescent, bearing a terminal umbellule of c. 10–20 sterile bacciform flowers 2–3 mm Ø, 2-celled, pedicels 3–4 mm tomentose sometimes with a ruff of hairs around the pseudo-fruits, subtended by early-caducous small fimbriate bracts; lateral branches 2½–3 cm long, with two opposite bracts (2–3 mm) about the middle, bearing a terminal head (8 mm Ø without corollas) of c. 15–30 sessile flowers, subtended by inconspicuous ovate tomentose bracts. *Calyx* an obsolete rim. Corolla in bud c. 1 mm long. Stamens 3. Ovary 3-celled. *Fruiting head* 10–12 mm Ø; drupes c. 6 mm long, crowded, sessile, 3-angled; seeds 3.

*Distr. Malesia*: Philippines (Luzon).

*Ecol.* In primary dipterocarp forest, on rocky slopes near streams, 300–400 m.

*Note.* Closely allied to 40. *O. luzoniense* and 27. *O. pectinatum*, but the combination of long-fringed petiolar crests, pubescent inflorescence branches, excessively bristly bracts and 3-merous flowers is distinctive.

**34. *Osmoxylon eminens* (BULL.) PHILIPSON**, *Blumea* 23 (1976) 114. — *Trevesia eminens* BULL, Cat. New Plants (1884) 17; Retail List (1885) 64, fig. — *Boerlagiodendron mindanaense* MERR. Philip. J. Sc. 3 (1908) Bot. 154. — *Boerlagiodendron eminens* (BULL) MERR. En. Philip. 3 (1923) 223.

Small tree, up to 10 m, with few stout branches. *Leaves* large, forming terminal crowns, glabrous when mature, young inflorescence densely furfuraceous; petiole to 1 m, stout (to 2 cm Ø), flattened above, base clasping the stem, heavily lenticellate, prolonged as a stipular ligule 2 cm long, bicuspid, often with scales or bristles on the back, and bearing few to several entire, fimbriate or occasionally long setose crests; blade to 60 cm long, palmately 10–19-lobed, base cordate, lobes reaching to near the base, lanceolate to oblong, up to 15 cm wide, in outline either strap-shaped or irregularly pinnatisect, or the central lobe occasionally distinctly tripartite, margin coarsely and irregularly dentate, apex acuminate. *Inflorescence* a terminal compound umbel c. 40 cm Ø; peduncle stout c. 6 cm, 1½ cm wide, bearing many lanceolate scaly bracts 3–6 cm long; primary rays numerous, rigid, flattened, 9–12 cm long, 6–10 mm broad, bearing opposite oblong scaly bracts (2–3 cm long) at the apex, each ending in three branches; central branch ½–1 cm long, terminating in an umbellule (3–5 cm Ø) of c. 20–40 sterile bacciform flowers, 7 mm Ø, 2–3-celled, pedicels 1–2 cm long, surrounded by an involucre of small bracts (to 8 mm long); lateral branches c. 12 cm long, with opposite bracts (6–10 mm long) near the middle, terminating in a head of c. 50–60 sessile flowers, 1½–2 cm Ø (with corollas), heads spherical at anthesis, ovoid after corollas absciss;



bracts between the flowers very small. *Calyx* rim obsolete. Corolla 5–6-lobed, tubular below, 4–5 mm long. Stamens 4–6, filaments 7 mm long, anthers  $1\frac{1}{2}$  mm long. Ovary 2–3 mm long (at anthesis), 5–6-celled. *Fruits* crowded in dense ovoid heads 3–4 by  $2\frac{1}{2}$ –3 cm, drupes c. 9 by 5 mm, 5–6-angled by mutual pressure, narrowed to the base, crowned by the persistent stigmatic boss; pyrenes crustaceous; endosperm wrinkled.

Distr. Micronesia: Carolines; in *Malesia*: throughout the Philippines.

Ecol. In primary forest from low altitude (100 m) to ridge forest and mossy forest at 950 m, often in shady ravines.

Vern. Cf. MERRILL: *apalong* or *apulong*, Bis., *bunglui-babae*, *piña-piña*, Sul., *mangunpulun*, Bag., *palad-ulot*, S.L.Bis., *ulo-ulo*, C.Bis.; in addition: *lolobongan*, Lan.

Notes. This is the most widespread and most frequently collected species in the Philippines. It is also the most striking. Its large, many-lobed, fan-shaped leaves and the strong inflorescences, with globular flower-heads and large clusters of pseudo-fruits are distinctive. Only 16. *O. pulcherrimum* resembles it somewhat in its leaf characters, but the central branches of the inflorescence rays of that species are much longer and its pseudo-fruits are sessile.

The inflorescence branches are described as dull reddish brown, the flowers as light orange, and the fruits as indigo-black.

**35. *Osmoxylon serratifolium* (ELMER) PHILIPSON**, *Blumea* 23 (1976) 114. — *Boerlagiodendron serratifolium* ELMER, Leaf. Philip. Bot. 2 (1908) 505; MERR. En. Philip. 3 (1923) 224.

Sparingly branched shrub to 5 m. *Petiole* to 50 cm long, channelled above, clasping base prolonged as an obtuse stipular ligule, and with few narrow  $\pm$  fimbriate crests around the base of the petiole; blade to 50 cm long, base cordate, palmately lobed (up to 11 lobes), lobes extending to within about  $\frac{1}{3}$  from the base, narrowly elliptic, margin serrate (or slightly lobulate), apex acuminate, sinuses narrowly rounded. *Inflorescence* a terminal compound umbel c. 30 cm  $\varnothing$ ; peduncle stout, bracteate; primary rays 20–30, 4–5 cm long, 5–6 mm wide, flattened, subtended by lanceolate bracts 3–5 cm long, sometimes with bristles on the back, and bearing similar opposite terminal bracts  $2\frac{1}{2}$  cm long, each terminating in three branches; central branch 12–15 mm long, terminating in an umbellule (3–4 cm  $\varnothing$ ) of c. 20–25 sterile bacciform flowers 5–6 mm  $\varnothing$ , 3–4-celled, pedicels to 10 mm, interspersed with persistent small bracts; lateral branches c. 9 cm long, with opposite bracts (c. 6 mm long) 2–3 cm from the base, terminating in a spherical head of c. 30 sessile flowers c.  $1\frac{1}{2}$  cm  $\varnothing$  (in bud), bracts between the flowers very small, obtuse, fimbriate. *Calyx* rim obsolete. Corolla 5–7-lobed above, tubular below, 5 mm long.

Stamens 5–6, exserted, filaments 7 mm long, anthers 2 mm long. Ovary 3 mm long, 5-celled. Fruit unknown.

Distr. *Malesia*: Philippines (Leyte, Camiguin, Panay).

Ecol. ELMER noted that this species was rare in the low hills of Leyte.

Notes. The flowers are orange-yellow (salmon), the fruits dark purple.

The inflorescence is very similar to that of 34. *O. eminens*, but the leaves lack the many strong fan-like ribs of that species.

**36. *Osmoxylon celebicum* PHILIPSON**, *Blumea* 23 (1976) 115. — *Boerlagiodendron celebicum* HARMS ex KOORD. Minah. (1898) 489, *nomen*.

A small, sparsely branched tree, 6 m high. Large leaves forming terminal crowns; petiole 50 cm by 8 mm, flattened above, with a sheathing base prolonged as a strong stipular ligule 3 cm long with branched fibrous setae on the outer surface, and with several crests bearing similar setae on the lower part of the petiole; blade 50 cm  $\varnothing$ , base emarginate, deeply 9-lobed, lobes narrowly elliptic to lanceolate, narrowed towards the sinuses, apex broadly cuneate, margin minutely and remotely serrate, sinuses broadly rounded. *Inflorescence* a terminal compound subspherical umbel c. 20 cm  $\varnothing$ ; peduncle short, stout (15 mm wide) with large setose bracts (c. 4 cm long) below and among the primary rays; primary rays c. 15, c. 6 cm long, 5 mm broad, with a pair of large setose bracts (22 by 10 mm) at the apex, each ending in three branches; central branch c. 6 by 2 mm, terminating in an involucre of setose ovate bracts (c. 4 mm long) and an umbel of c. 20–30 sterile bacciform flowers (c. 3 mm  $\varnothing$  when dry, 2–3-celled, on pedicels 6–10 mm long) interspersed with bracts covered with crisp reddish-brown setulae; the two lateral branches c. 2 cm long, with opposite setulose bracts (c. 1 cm long) below the middle, terminating in a spherical head of c. 30–40 sessile flowers each subtended by a reddish brown setulose cymbiform bract. *Calyx* rim obsolete. Corolla c.  $2\frac{1}{2}$  mm long in bud (not seen in open condition). Stamens 5. Ovary subcylindric, c. 1 mm long in bud, 5-celled; disk with a central stigmatic boss. Fruit unknown.

Distr. *Malesia*: Celebes (Minahasa, Manado).

Ecol. On rich volcanic sand, at 10 m.

Vern. *Sinomaha*.

Note. The flower buds are orange and the fruits deep purple.

**37. *Osmoxylon talaudense* PHILIPSON**, *Blumea* 23 (1976) 115.

Shrub or small tree, to 6 m, glabrous. *Leaves* at the ends of the stout branches; petiole to 60 cm, broadly channelled above, clasping base prolonged as a stipular ligule c. 2 cm long, and bearing 2–3 fimbriate crests; blade c. 50 cm long truncate to cordate at the base, palmately 7–11-lobed to within



Fig. 16. *Osmoxylon micranthum* (HARMS) PHILIPSON. a. Habit,  $\times \frac{1}{2}$ , b. flower, c. false fruit and ditto in CS,  $\times 15$ , d. CS of fruit,  $\times 6$  (a-c KANIS 1384, d PULLEN 428). Drawn by W. R. PHILIPSON.



$\pm \frac{1}{4}$  of the base, lobes elliptic oblong slightly narrowed towards the rounded sinuses, apiculate, margin denticulate to undulate. *Inflorescence* a terminal compound umbel, peduncle 1–2 cm, bearing broad ovate bracts 2–3 cm long, with bristles on the back, (similar persistent bracts subtend the primary rays); primary rays c. 15, c. 3–4 cm long, 4 mm wide, flattened, bearing opposite terminal persistent bracts  $1\frac{1}{2}$ –2 cm long, sometimes with a few bristles on the back, ending in three branches; central branch 8–10 mm long, terminating in an umbellule 2 cm  $\varnothing$  of 15–20 sterile bacciform flowers (4 mm  $\varnothing$ , 2-celled) surrounded by an involucre of obtuse bracts 1–2 mm long, pedicels 5–7 mm; lateral branches  $4\frac{1}{2}$ –5 cm long, bearing opposite ovate persistent bracts (3–7 mm long) c. 5–10 mm above the base, terminating in a dense head c. 1 cm  $\varnothing$  of 30–40 sessile flowers interspersed with inconspicuous obtuse bracts. *Calyx* rim obsolete. Corolla 5-lobed. Stamens 5. Ovary turbinate,  $1\frac{1}{4}$  mm long, 5-celled. Fruit in spherical heads 2 cm  $\varnothing$  (when dry); drupes c. 9 by 6 mm, obovoid, 5-ribbed.

Distr. *Malesia*: N. Moluccas (Talaud Is.: Karekelong and Salebabu).

Ecol. Common in forest, besides streams, from near sea-level to 100 m.

Vern. *Laripatu*, Talaud.

Note. The flower is yellow-orange and the fruit dark purple. For a discussion of the distinctive features, see under 31. *O. sessiliflorum*.

**38. *Osmoxylon micranthum* (HARMS) PHILIPSON**, *Blumea* 23 (1976) 115. — *Boerlagiendendron micranthum* HARMS, Bot. Jahrb. 56 (1920) 379. — *Boerlagiendendron sayeri* HARMS, l.c. 379, f. 1 a–j. — *Eschweilera gawadensis* BAKER f. J. Bot. 61 (1923) 22. — *Boerlagiendendron tricolor* PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 11. — Fig. 16.

A sparsely branched shrub to 8 m, sometimes trailing or semi-scandent, young parts uniformly setulose, buds without cataphylls. *Leaves* in terminal clusters; petiole up to 30 cm, rather narrow (2–4 mm  $\varnothing$ ), becoming sparsely setulose, channelled above, with a sheathing base prolonged as a membranous stipular ligule up to 3 cm long, and with a number of lacerate crests encircling the lower part of the petiole; blade deeply 3–5- or more rarely 7-lobed, or below the inflorescence sometimes simple, base cordate or emarginate, the central lobe up to 30 cm long, the lobes oblong, lanceolate or broadly elliptic, entire or irregularly lobed or incised, or with small sub-lobes, apices long cuspidate, acute, margin serrate, sinuses between the lobes broad and rounded, surfaces become sparsely setulose to subglabrous. *Inflorescence* a terminal compound umbel, often appearing subterminal by growth of a leafy branch at the base of the peduncle; peduncle short (1–2 cm), heavily setulose, occasionally with a flowering ray arising from the axils of bracts on or below the

peduncle, bearing distally many lanceolate bracts 5–10 mm long; primary rays 12–18, 10–20 mm long, setulose, with two lanceolate bracts at the apex, each ray ending in three branches; the central branch very short (2–3 mm) bearing a subglobose umbel of many (c. 40) small sterile bacciform flowers (c.  $1\frac{1}{2}$  by 1 mm) with filamentous pedicels c. 2 mm long, and 1–2 cells each with 1 abortive ovule; the two lateral branches c. 2 cm long, with two minute bracts about their middle, setulose, terminating in a head of c. 20 sessile flowers surrounded by an involucre of small rounded bracts. *Calyx* rim obsolete. Corolla 4(–5)-lobed, united below, c. 2 mm long. Stamens 4(–5), filaments ribbon-like elongating beyond the corolla tube at anthesis, 3–4 mm, anthers small. Ovary shortly subcylindric, c. 1 mm high, faintly angled, glabrous, 1–5-, usually 4-celled, disk fleshy, rising slightly to the central stigmas. *Fruit* an ellipsoid drupe with 1–5 cartilaginous pyrenes; seeds with smooth endosperm.

Distr. *Malesia*: New Guinea (Irian Jaya: Idenburg R. to Milne Bay Distr.).

Ecol. In primary forest from the foothills to the montane mossy forest, often in swampy or deeply shaded situations, 700–2400 m.

Vern. *Diande*, Chimbu, *kenata*, Okapa.

Note. The inflorescence branches are often red or purple, and the flowers either orange or reddish with yellow anthers. The ripe fruits are deep purple or black. The shape and size of the leaf can vary greatly, even on the same plant. The ovary usually has 4 cells, but plants with 3, 2 and 1 occur. Since these are alike in other respects they have been treated as a single species. Although the type of *Boerlagiendendron tricolor* has an ovary with 5 cells and is from much further west than other gatherings, it is not considered to be specifically distinct.

**39. *Osmoxylon trilobatum* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 116. — *O. cumingii* SEEM. J. Bot. 6 (1868) 141, *nomen*. — *Boerlagiendendron trilobatum* MERR. Philip. J. Sc. 2 (1907) Bot. 289; En. Philip. 3 (1923) 224.

Slender shrub or small tree up to 5 m, becoming glabrous except for slight pubescence on the inflorescence. *Leaves* clustered near the ends of the branches; petioles to 25 cm, c. 3 mm wide, clasping base prolonged as a broad stipular ligule c. 1 cm long, and with 2–3 entire, or obscurely fimbriate, often recurved crests surrounding the base of the petiole; blade 3- or occasionally 5-lobed (leaves below the inflorescence sometimes simple), to 30 by 28 cm, base broadly cuneate, rounded or truncate (emarginate in 5-lobed leaves), lobes about  $\frac{1}{2}$ – $\frac{2}{3}$  of the blade, narrowly or broadly oblong, often slightly narrowed below and sharply acuminate to caudate, margin serrate. *Inflorescence* a terminal compound spherical umbel, 7–15 cm  $\varnothing$ , either rather compact or branches lax; peduncle 2–3 cm with broad ovate bracts; primary rays 8–20

or more, slightly pubescent,  $1\frac{1}{2}$ –4 cm long, subtended by ovate bracts 5–10 mm long, opposite ovate bracts at the apex, 1–3 mm long; central branch  $1\frac{1}{2}$ –6 mm long, pubescent, bearing an umbel (1– $1\frac{1}{2}$  cm  $\varnothing$ ) of sterile bacciform flowers up to 5 mm  $\varnothing$ , 1–4-celled, pedicels 2–6 mm long, subtended by ovate bracts 1–3 mm long; lateral branches  $1\frac{1}{2}$ –3 cm with opposite small bracts about the middle, bearing a terminal head, c. 1 cm  $\varnothing$  of c. 8–20 flowers, surrounded by an involucre of small rounded pubescent bracts, pedicels c. 1 mm or less (up to 3 mm in fruit). *Calyx* rim obsolete. Corolla 4–5-lobed above, tubular below, 2–3 mm long. Stamens 4–5, exserted. Ovary subcylindric, 4–5-celled. Fruit a spherical drupe (when dry 4–5-ribbed, 7 by 5 mm).

Distr. *Malesia*: widespread in the Philippines (Luzon to Mindanao).

Ecol. In primary forest, frequently beside streams in damp ravines, from the lowland at 75 m to 750 m.

Vern. *Kamay-kamay*, Tag., *ayum*, C.Bis.

Note. Sparingly branched but wide-spreading slender shrub, with yellowish bark, at first heavily dotted with brown lenticels. The flowers are white and the ripe fruit smooth and purple.

**40. *Osmoxylon luzoniense* (MERR.) PHILIPSON**, *Blumea* 23 (1976) 116. — *Boerlagiodendron luzoniense* MERR. Philip. J. Sc. 3 (1908) Bot. 252; En. Philip. 3 (1923) 223. — *Boerlagiodendron clementis* MERR. Philip. J. Sc. 3 (1908) Bot. 155; En. Philip. 3 (1923) 222. — *Boerlagiodendron agusanense* ELMER, Leaf. Philip. Bot. 7 (1914) 2330; MERR. En. Philip. 3 (1923) 222. — *Boerlagiodendron diversifolium* MERR. Philip. J. Sc. 10 (1915) Bot. 333; En. Philip. 3 (1923) 223.

Erect, unbranched or sparsely branched shrub or tree to 8 m, becoming glabrous except for the inflorescence. *Leaves* clustered at the ends of the branches; petiole to 40 cm, with a clasping base prolonged as a short stipular ligule, and with several basal entire or shortly fimbriate crests; blade to 33 cm  $\varnothing$ , base truncate or cordate, deeply palmately 3–7-lobed, sinuses broad, rounded, lobes elliptic, usually narrowed below, entire or with subsidiary lobes (the central lobe especially often narrow below and strongly pinnately lobed), apex acute, margin coarsely serrate, coriaceous; uppermost leaves often reduced and simple. *Inflorescence* a terminal compound, subsessile umbel 10–15 cm  $\varnothing$ ; primary rays c. 20–30, 2–3 cm long, subtended by lanceolate furfuraceous and  $\pm$  fimbriate bracts, furfuraceous villose or  $\pm$  hirsute, with opposite rounded or lanceolate hirsute bracts at the apex, each ending in three branches; central branch c. 2–8 mm long, hirsute, ending in an involucre of minute bracts (1 mm) surrounding a globose (2 cm  $\varnothing$ ) umbellule of c. 15–20 sterile flowers (c. 6 by 6 mm, 2–3-celled), pedicels 2–3 mm, hirsute; lateral branches c.  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long at anthesis,

with an articulation about the middle,  $\pm$  hirsute, ending in a globose head, 2 cm  $\varnothing$  (with open corollas), with ovate tomentose obtuse bracts, c. 2 mm long; flowers 30–40,  $\pm$  sessile (rarely pedicels to 2 mm). *Calyx* rim obsolete. Corolla 4–5-lobed above, tubular below,  $3\frac{1}{2}$ –4 mm long. Stamens 4–5, exserted, filament stout, 5 mm, anther 1 mm long. Ovary 4–5-celled. *Fruit* 6 by 5 mm (dry), strongly 4–5-ribbed.

Distr. *Malesia*: widespread in the Philippines (Luzon to Mindanao), also in N. Celebes.

Ecol. In forests, often by streams and on ridge in mossy forest, 280–1650 m.

Vern. Philippines: *bolwang hi inalahan*, If., *iyangnok*, Mbo, *malakapayas*, S.L.Bis., *molonpolon*, Buk., *tañgan-tañgan-batu*, Buk., *tachung*, *vañgang*, Ig.

Notes. Inflorescence yellow to red (salmon), fruits blue-black or purple.

MERRILL did not liken his *Boerlagiodendron diversifolium* (from Mindanao) to this species, no doubt because he gave importance to the occurrence of variable leaves and the 5-merous flowers. However, specimens from Luzon may possess simple leaves below the umbel, and both 4- and 5-merous flowers occur in both Luzon and Mindanao. The greater range of material now available establishes the identity of the two species. Similarly, no features seem to distinguish *Boerlagiodendron clementis*, and *B. agusanense* though a greater range of collections would be desirable.

The species is treated here in a broad sense. The inflorescence characters of most specimens are uniform, being hirsute and with the bracts at the apex of the primary rays obtuse and short. Some specimens (CURRAN 5088, ELMER 16762) have longer lanceolate bracts with some bristles on the back. The northernmost specimen, from Ilocos Norte, has finer and less hairy inflorescence rays (recalling 39. *O. trilobatum*), but the foliage agrees with this species. Leaf-shape is more variable, even on the same specimen. Other species which resemble *O. luzoniense* in some respects are: 32. *O. camiguinense* with broader, shallower lobing, a more delicate inflorescence, and tri-merous flowers; 27. *O. pectinatum* with glabrous inflorescence branches and long-pectinate petiolar crests; and 26. *O. humile* with pedicelled flowers forming less dense heads.

A specimen from Surigao Province (BS 83562) has a most interesting abnormal structure. The central branches of the inflorescence rays bear heads of apparently fertile flowers, with lobed corollas and exserted stamens.

**41. *Osmoxylon insigne* (MIQ.) BECC.** *Malesia* 1 (1878) 195; PHILIPSON, *Blumea* 23 (1976) 117. — *Trevesia insignis* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 222. — *Trevesia palmata* var. *insignis* CLARKE, Fl. Br. Ind. 2 (1879) 732, *pro nomen*. — *Eschweilera insignis* (MIQ.) BOERL. Ann. Jard. Bot.



Btzig 6 (1887) 122. — *Boerlagiodendron insigne* (MIQ.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 31.

A glabrous tree. *Leaves* large, palmately lobed; petiole to 45 cm, 8–10 mm wide, flattened above, with a sheathing base prolonged as a stipular ligule, numerous fimbriate crests around the base of the petiole, and irregular tufts of bristles along the whole length of the petiole; blade to 55 cm  $\varnothing$ , deeply 5–7-lobed, the sinuses broadly rounded and c. 4–5 cm from the base of the blade, lobes pinnatilobed, with a narrow base and an attenuated apex, margins serrate. *Inflorescence* a terminal compound umbel c. 16 cm  $\varnothing$ ; peduncle stout, with lanceolate bracts ( $1\frac{1}{2}$ –2 cm long) subtending the primary rays; primary rays 25–30, c. 4 cm long, bearing 2 caducous lanceolate bracts (c. 1 cm long) at the apex, each ray ending in 3 branches; central branch c. 12–16 mm long, bearing an umbel (c. 2 cm  $\varnothing$ ) of c. 20 sterile ovoid bacciform flowers (c. 4 mm long when dry) with pedicels c. 4–6 mm long, and 3-celled; two lateral branches c.  $3\frac{1}{2}$  cm long, with an articulation about the middle, terminating in an umbellule (c. 2 cm  $\varnothing$ ) of c. 10–15 flowers on short stout pedicels c. 2 mm long, umbellules surrounded by a receptacular rim after caducous bracts have abscised. *Calyx* rim minute. Petals c.  $3\frac{1}{4}$  mm long in bud (when dry), with 8–9 lobes above, tubular below. Stamens 8–9, with stout filaments. Ovary cylindric, 8–9-celled; disk with a central double row of pustulate stigmas. Fruit unknown.

Distr. *Malesia*: Moluccas (Batjan).

Note. Tufts of bristles along the entire length of

the petiole together with the pinnatifid lobes of the leaf are distinctive. SEEMANN (J. Bot. 4, 1866, 353) referred to 5-flowered umbels with 5-angled drupes, but this probably relates to the New Guinea specimen which he included under this name.

#### Insufficiently known

*Boerlagiodendron ledermannii* HARMS, Bot. Jahrb. 56 (1920) 383; PHILIPSON, Blumea 23 (1976) 117. — Type: LEDERMANN 12293.

HARMS compared this species with *Boerlagiodendron geelvinkianum*. The size of the foliage and flowers prevents it from being included within that species. If it represents a local species, it has not been re-collected since the original gathering of LEDERMANN in 1912. The type specimen, which was incomplete, was destroyed during the war.

*Boerlagiodendron monticola* HARMS in K. Sch. & Laut. Fl. Schutzgeb. Nachtr. (1905) 330; PHILIPSON, Blumea 23 (1976) 117. — Type: SCHLECHTER 14471.

The incomplete type specimen, gathered by SCHLECHTER, was destroyed during the war. This species was evidently similar to 38. *Osmoxylon micranthum*, but the ovary was possibly 10-celled. I have tentatively identified ROBBINS 1644 as this species: it is close to *O. micranthum* but its ovary, with 8 cells, is outside the range of variation of that species and the pedicels are longer (in fruit). Its distribution (foothills of Adalbert Range) is not dissimilar to that of *Boerlagiodendron monticola* (Torricelli Mts).

### 8. ARTHROPHYLLUM

BL. Bijdr. (1826) 878; DC. Prod. 4 (1830) 266; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 27; BTH. in B. & H. Gen. Pl. 1 (1865) 944; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 54; KOORD. Atlas 4 (1916) f. 675 & 676; HUTCH. Gen. Fl. Pl. 2 (1967) 80; STONE, Gard. Bull. Sing. 30 (1977) 276; PHILIPSON, l.c. 299, f. 1–16; Adansonia 17 (1978) 329. — *Mormoraphis* JACK ex WALL. Cat. (1831) n. 4931, nomen. — *Eremopanax* BAILL. Adansonia 12 (1878) 158. — Fig. 17, 19–23.

Unarmed, sparingly branched trees or shrubs. *Leaves* on vegetative shoots and lower leaves spirally arranged, imparipinnate, often crowded at the end of the branches, those on flowering branches often opposite, smaller, or reduced to a single leaflet; petiole terete; rachis articulated at the insertion of the pinnae and leaflets; leaflets entire; stipular sheath clasping, small, ligule a mere rim. *Inflorescence* consisting of compound umbels, either solitary and terminal or more commonly borne on a cluster of specialized leafy branches arising from the axils of the uppermost leaves; pedicels not articulated. *Flowers* bisexual. Calyx an undulate rim, sometimes with indistinct teeth, persistent. Petals 4–6, valvate in bud. *Stamens* 4–6, anthers curved, basifixed. Ovary turbinate, 1-celled; disk



Fig. 17. Habit of *Arthrophyllum diversifolium* BL. (Photogr. HOOGLAND, Bogor).



fleshy, rising in the centre to the  $\pm$  sessile capitate stigma. *Fruit* ovoid or spheroidal, often oblique; exocarp leathery; endocarp cartilaginous. *Seed* solitary, pendulous; endosperm deeply transversely ruminate.

Distr. About 31 *spp.* (17 in Malesia) extending from the Nicobar Is. and Indo-China to the Philippines, New Guinea and New Caledonia. Fig. 18.

Notes. The principal distinctive characters of this isolated genus are the single-celled ovary and the arrangement of the umbels on specialized lateral branches in the majority of the species.

The present treatment, following that which I gave in 1977, *l.c.*, remains tentative until widespread field studies can be undertaken.

#### KEY TO THE SPECIES

1. Inflorescence becoming paniculate by the successive development of branches below the umbellules. Fig. 19a . . . . . 1. *A. proliferum*
1. Inflorescence a compound umbel.
  2. Inflorescence with four orders of branching.
    3. Leaflets lanceolate.
      4. Leaflets c. 4–7 cm long. Fig. 20f . . . . . 2. *A. ashtonii*
      4. Leaflets much longer . . . . . 3. *A. angustifolium*
    3. Leaflets broader.
      5. Pedicels (at early anthesis) c. 10 mm long.
        6. Peduncles of umbellules with bracts or their scars. Fig. 21a . . . . . 4. *A. ahernianum*
        6. Peduncles of umbellules without bracts or their scars. Fig. 21b. . . . . 5. *A. engganoense*
      5. Pedicels (at early anthesis) c. 5 mm long, or shorter.
        7. Leaves associated with the umbels rotund. Fig. 21e. . . . . 6. *A. collinum*
        7. Leaves (or leaflets) associated with the umbels ovate or elliptic.
          8. Leaves associated with the umbels ovate,  $\pm$  fleshy, with the lower surface smooth (lateral veins obscure). Fig. 21f . . . . . 7. *A. crassum*
          8. Leaves (or leaflets) associated with the umbels  $\pm$  elliptic, coriaceous or chartaceous, veins visible.
            9. Young parts glabrous . . . . . 8. *A. pacificum*
            9. Young parts with rufous tomentum.
              10. Umbels at anthesis with numerous filamentous pedicels. Fig. 21c. . . . . 9. *A. diversifolium*
              10. Umbels at anthesis with fewer stout pedicels. Fig. 21d . . . . . 10. *A. macranthum*
    2. Inflorescence with three (or fewer) degrees of branching.
      11. Leaflets membranaceous or chartaceous.
        12. Mid-leaflets c. 16 cm long. . . . . 11. *A. papyraceum*
        12. Mid-leaflets c. 8 cm long or shorter.
          13. Leaflets usually 5–7 (Fig. 20a). Primary inflorescence branches usually short (c. 3–6 cm) and without articulations . . . . . 12. *A. maingayi*
          13. Leaflets more numerous (Fig. 20d). Primary inflorescence branches longer (10–20 cm), with one or more leafy nodes . . . . . 13. *A. kjellbergii*
      11. Leaflets coriaceous.
        14. Leaflets c. 5 . . . . . 14. *A. cenabrei*
        14. Leaflets more numerous.
          15. Petals and stamens 6 . . . . . 15. *A. pulgarens*
          15. Petals and stamens 4 or 5.
            16. Leaflets 6 cm long, or longer. Fig. 20b . . . . . 16. *A. montanum*
            16. Leaflets shorter. Fig. 20c . . . . . 17. *A. alternifolium*

1. *Arthrophyllum proliferum* PHILIPSON, Gard. Bull. Sing. 30 (1977) 302, f. 3–4. — Fig. 19a–b.

Medium-sized, glabrous tree. *Leaves* multijugate, up to 90 by 24 cm, of the flowering branches smaller with fewer pinnae or usually simple; petioles up to 28 cm, 5 mm  $\varnothing$ ; petiolules 1–1½ cm; leaflets obovate-oblong, c. 16 by 7 cm, chartaceous, margin slightly revolute, base broadly cuneate to truncate,

sometimes oblique, apex acute. *Inflorescences* terminating specialized plagiotropic shoots, bearing axillary flowering branches and ending in umbellules of a few flowers below which pairs or whorls of branches continue the growth of the inflorescence to produce an elongated panicle of umbellules; pedicels 7–8 mm (slightly longer in fruit). *Calyx* often with 5 indistinct teeth. Petals 5,



Fig. 18. Species density of *Arthrophyllum* BL. in Malesia; above the hyphen the number of endemic species, below it the non-endemics. Complete range of genus encircled; 17 of the total of 31 *spp.* occur in Malesia.

3 $\frac{1}{2}$  mm long, narrowly triangular. Stamens 5, filaments c. 2 mm, anthers reniform, c.  $\frac{1}{2}$  mm long. Ovary obconical, c. 2 mm long; disk fleshy, cushion-like; stigma capitate  $\pm$  sessile. *Fruit* ovoid, fleshy, capped by the calyx and the enlarged beak-like stylopodium, c. 10 by 5 mm when dry.

Distr. *Malesia*: E. New Guinea (Morobe Distr.).

Ecol. Mid-mountain rain-forest, reaching the canopy, on steep slopes, 300–1200 m.

Notes. The thick outer bark is grey-brown, fissured, and peeling in small flakes. Wood straw-coloured. Cut stems exude brown latex. The thick petals are yellow-green.

The flower and fruit are typical of this well-defined genus, but the branching of the inflorescence is unlike that found in all other species.

**2. *Arthrophyllum ashtonii* PHILIPSON, Gard. Bull. Sing. 30 (1977) 303, f. 12. — Fig. 20f.**

Slender small tree, to 5 m, with the leaves dispersed for some distance from the apex of the branches, young parts with brown scurfy tomentum which persists on the umbellules. *Leaves* multijugate, to c. 30 cm long; of the flower-bearing branches smaller with fewer pinnae, or simple; petioles slender, c. 7–9 cm; petiolules c. 4–7 mm; leaflets lanceolate to broadly lanceolate, 3–7 $\frac{1}{2}$  by 1–2 cm, thinly coriaceous, margin revolute, base broadly cuneate, apex tapered to subcaudate, veins channelled above, visible beneath. *Inflorescence* a terminal cluster of specialized leafy branches; main rays variable in length in the same inflorescence, the longest from c. 16–25 cm long with a pair of opposite simple leaves about the middle (with flowering branches in their axils) and ending in a whorl of secondary rays subtended by simple leaves; secondary rays 4–12 cm long, bearing simple leaves, usually in an opposite pair and terminating in compound umbels; umbellules with c. 8–10 flowers; pedicels 4–10 mm, furfuraceous. *Flower buds* c. 2 mm long, calyx a furfuraceous rim. Petals 5, broadly triangular. Stamens 5, anthers

curved, basifixed. Ovary glabrous, obconical, c. 1 mm long; stigma on a raised stylopodium at the centre of a flat disk. *Fruit* spheroidal, with a persistent stylopodium, c. 6 mm long when dry.

Distr. *Malesia*: Borneo (Sarawak and Brunei).

Ecol. Mossy forest on sandstone ridge, and in kerangas forest, 1000–1550 m.

Note. The small narrow leaflets are very distinctive. No other species with small leaflets has inflorescences which branch to the fourth degree.

**3. *Arthrophyllum angustifolium* RIDL, J. Fed. Mal. St. Mus. 10 (1920) 136; Fl. Mal. Pen. 1 (1922) 885; PHILIPSON, Gard. Bull. Sing. 30 (1977) 304.**

Shrub or small tree, up to 5 m, young parts rufous-tomentose, glabrescent. Lower *leaves* multijugate, rachis dilated, c. 70–90 by 30–40 cm; petioles c. 15–22 cm, 3–5 mm wide, ligule a rim c. 2 mm long; petiolules c. 7–10 mm long; leaflets coriaceous, lanceolate, c. 15–22 by 1 $\frac{1}{2}$ –2 $\frac{1}{2}$  cm, tapering to an acute or obtuse apex, base cuneate, margin slightly revolute; upper leaves reduced, mostly unifoliolate, opposite, broader, with petioles 2–4 cm long. *Inflorescence* a terminal cluster of specialized leafy branches; main rays 30 cm (or more) long, bearing simple leaves in opposite pairs with small flowering branches in their axils, ending in a whorl of c. 10–12 secondary rays subtended by simple leaves; secondary rays 8–12 cm long, bearing pairs of simple leaves, and terminating in an umbel of 5–12 tertiary rays c. 2–3 cm long, with bract scars about the middle, and ending in an umbellule of c. 8–12 flowers, pedicels c. 5 mm. Petals 5, 2–3 mm long in bud. Stamens 4. Ovary turbinate, inconspicuous at anthesis; disk fleshy; stigma  $\pm$  sessile. *Fruit* spheroidal, c. 5 by 5 mm when dry, calyx and stylopodium small.

Distr. *Malesia*: Malay Peninsula (Perak) and Borneo (Brunei).

Ecol. Forest and old regenerated forest on peat swamp at low altitude or on ridges.

Note. The lanceolate leaflets are unlike those of any other species. The grey bark is minutely fissured and bears many small orange lenticels. The wood is soft and white. The Malayan and Bornean specimens are similar, except that the flower buds are larger in the Brunei plant.

**4. *Arthrophyllum ahernianum* MERR. Philip. J. Sc. 1 (1906) Suppl. 109; En. Philip. 3 (1923) 235; PHILIPSON, Gard. Bull. Sing. 30 (1977) 304, f. 13. — *A. pinnatum* (non CLARKE) F.-VILL. Nov. App. (1880) 103; VIDAL, Synopsis Atlas (1883) 28, t. 55 f. c. — *Macropanax* sp. VIDAL, Rev. Pl. Vasc. Filip. (1886) 145. — *A. sablanense* ELMER, Leaf. Philip. Bot. 1 (1908) 331. — *A. borneense* MERR. Pl. Elm. Born. (1929) 231, non BAKER, 1896. — *A. elmeri* MERR. Webbia 7 (1950) 319. — *A. merrilliana* FURTADO, Gard. Bull. Sing. 19 (1962) 185. — Fig. 21a.**





Fig. 19. *Arthrophyllum proliferum* PHILIPSON. a. Part of inflorescence in fruiting state,  $\times 1/2$ , b. ditto, showing detail of ultimate branches in flowering stage, nat. size. — *A. maingayi* PHILIPSON. c. Terminal inflorescence,  $\times 1/2$ . — *A. montanum* RIDL. d. Single flowering shoot,  $\times 1/3$  (Courtesy Gard. Bull. Sing. 30, 1977).

Tree up to 15 m, young parts with rufous tomentum. Leaves clustered at the ends of the branches, multijugate, up to 200 by 60 cm; of the flower-bearing branches smaller with fewer pinnae, or simple; petiole stout, up to 35 cm; petiolules 5–20 mm; leaflets ovate-oblong, occasionally oblong-lanceolate, up to 35 by 12 cm, membranaceous or chartaceous, margin revolute, base cuneate to rounded, usually oblique, apex short acuminate. Inflorescence a whorl of specialized leafy branches forming a terminal crown; main rays up to 150 cm (or more), bearing pinnate leaves usually in 1–2 opposite pairs, and with flowering

branches in the upper axils, ending in a whorl of secondary rays subtended by pinnate or more rarely simple leaves; secondary rays up to 30 cm bearing simple or pinnate leaves in opposite pairs, and terminating in compound umbellules; umbellules with c. 10–20 flowers c. 3 cm  $\varnothing$ ; peduncles with 1–2 pairs of small simple, often caducous leaves; pedicels c. 1 cm (at anthesis) subtended by minute caducous bracts. Petals 5, 4 mm long. Stamens 5, anthers curved. Ovary turbinate; disk fleshy; stigma  $\pm$  sessile. Fruit c. 10 by 7 mm, ellipsoidal, calyx and stylopodium forming a prominent beak.

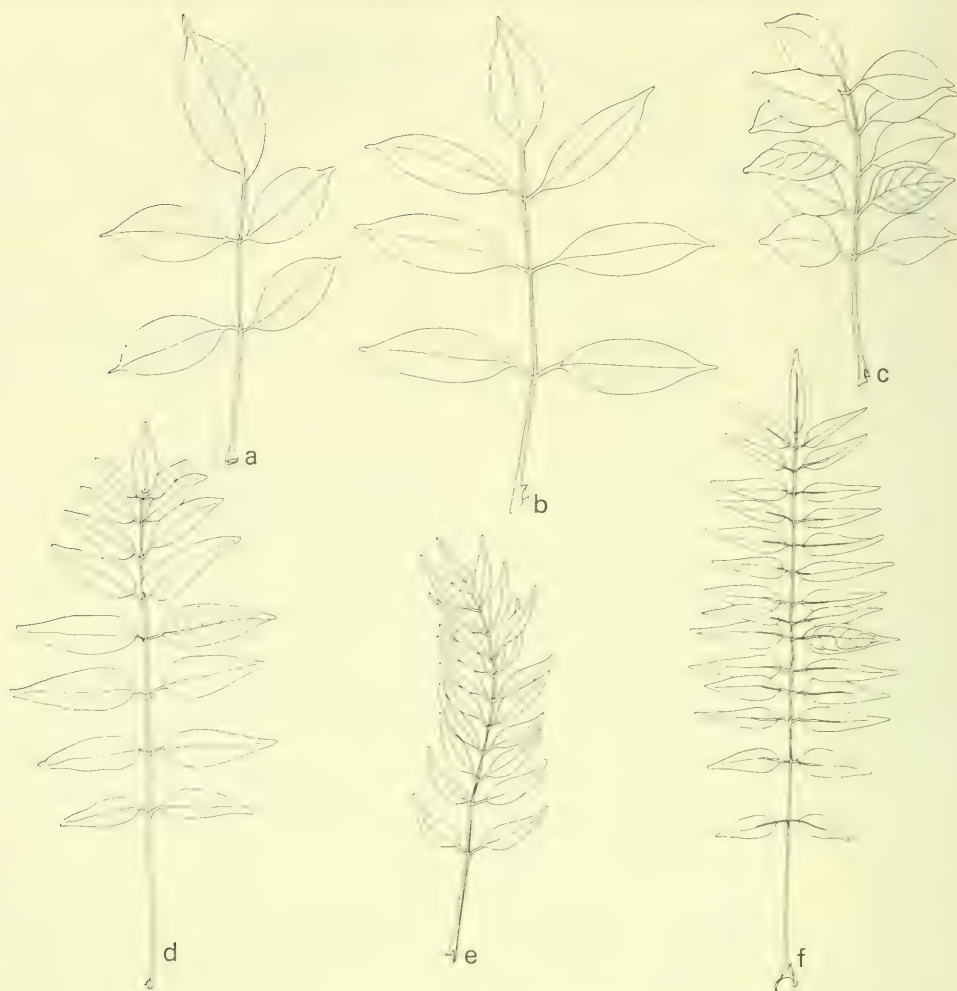


Fig. 20. Foliage leaves of *Arthrophyllum* spp. a. *A. maingayi* PHILIPSON, b. *A. montanum* RIDL., c. *A. pulgarense* ELMER, d. *A. kjellbergii* PHILIPSON, e. *A. alternifolium* MAINGAY ex RIDL., f. *A. ashtonii* PHILIPSON. All  $\times \frac{1}{3}$  (Courtesy Gard. Bull. Sing. 30, 1977).

Distr. *Malesia*: N. Borneo and throughout the Philippines to the northern Moluccas (Talaud, Ternate).

Ecol. Primary and second-growth forest, from the lowlands to 1000 m.

Vern. Philippines, cf. MERRILL: *alabihig*, *dokloi*, P.Bis., *binaláyon*, C.Bis., *danipo*, Ig., *higin*, Mang., *malapapáya*, *puyga-puygáhan*, Tag., *pamalatāngen-a-purau*, Ilk. Additional names: Philippines: *lulpo*, Luzon, *mayari*, Mindoro, *bungyo*, Palawan; Moluccas: *langator'a*, Talaud.

Notes. This species replaces the more westerly 9. *A. diversifolium* which it closely resembles. It is

characteristically larger in all its parts, particularly in the size of the individual flowers and the length of their pedicels. There are fewer flowers in an umbellule.

The distinction between these two species is not always easy to make, especially when the material is fragmentary; PHILIPSON, l.c. A few specimens from the Philippines appear very similar to *A. diversifolium*, and it is possible that this species extends beyond Borneo. I have regarded them as part of the range of variation of *A. ahernianum*. Similarly, at least one specimen from S. Borneo approaches *A. ahernianum* in appearance.



**5. *Arthrophyllum engganoense* PHILIPSON, Gard. Bull. Sing. 30 (1977) 305, f. 14. — Fig. 21b.**

Tree to 21 m high, becoming glabrous. Lower leaves imparipinnate, multijugate, 60 cm long or more; petiole 24 cm, 6 mm wide, rachis articulated at the insertion of the leaflets; petiolules 10–18 mm; leaflets broadly elliptic to elliptic-oblong, c. 12–15 by 6–7 cm, base rounded with a short asymmetrical cuneate centre, apex shortly apiculate, margin entire, often undulate chartaceous. Flowering branches c. 40 cm; leaves opposite, simple, or unifoliate, petiolules c. 5–7 cm, leaflets ovate, c. 13 by 6 cm, with inflorescence branches in their axils; ending in a whorl of simple leaves surrounding a compound umbel to 30 cm  $\varnothing$ ; secondary rays c. 8, c. 10–15 cm long at flowering, slender (2 mm  $\varnothing$ ) and striate, each bearing a pair of small leaves about the middle (sometimes with inflorescences in their axils) and ending in an umbel; tertiary rays c. 8, slender, c. 20–40 mm long, without bracts; tertiary rays pedicels c. 5–10 per umbellule, c. 10–15 mm at anthesis. Calyx an undulate rim. Petals 5, c. 2 mm long in bud. Stamens 5, anthers curved. Ovary turbinate, obscurely ribbed, c. 2½ mm long at anthesis. Fruit ellipsoid, c. 10 by 7 mm, with a rather small persistent calyx and stylodipodium.

Distr. *Malesia*: S. Sumatra (Enggano I.), two collections.

Ecol. Forest at low altitude, up to c. 100 m.

Vern. *Langkapu utan kaauh*, Enggano.

Note. The two known collections of this species are very similar and contrast with the widespread 9. *A. diversifolium* because of the few-flowered umbellules with long, spreading pedicels.

**6. *Arthrophyllum collinum* PHILIPSON, Gard. Bull. Sing. 30 (1977) 305, f. 17. — Fig. 21e.**

Sparingly branched shrub or small tree up to 12 m, all young parts with dense, rufous tomentum which persists on flowers and inflorescences. Leaves multijugate, up to 60 (or more) by 32 cm; of the flowering branches smaller with fewer pinnae or more frequently unifoliate, leaflets more rotund and with longer petioles; petiole up to 20 cm; petiolules c. 1 cm; leaflets oblong, broadly elliptic or rotund, up to 16 by 7 cm, coriaceous, margin slightly revolute, base truncate to rounded, unequal, apex rounded, obtuse, or shortly and bluntly apiculate, midrib prominent, lateral veins usually clearly visible below, upper surface frequently rugose. Inflorescence a cluster of specialized leafy branches forming a terminal crown; main rays up to 60 cm long, bearing one or more, rarely two, opposite pairs of usually unifoliate rotund leaves often with flowering branches in their axils, and ending in a whorl of secondary rays, subtended by usually unifoliate leaves; secondary rays up to 17 cm, bearing a pair of unifoliate leaves with flowering branches in their axils, and terminating in compound umbellules; tertiary rays c. 5–10,

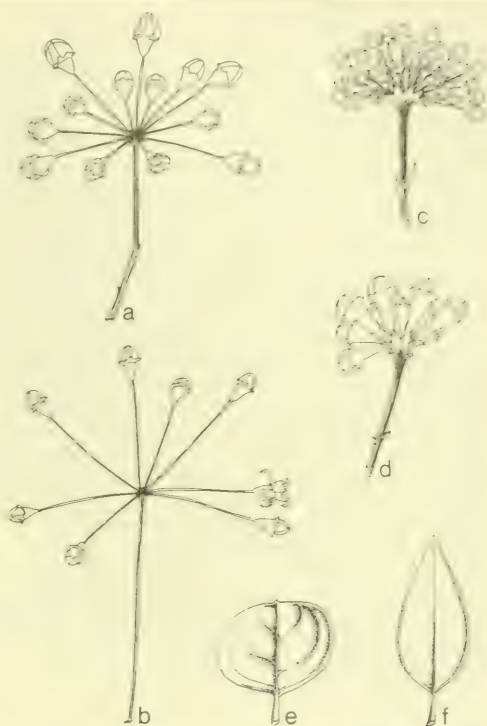


Fig. 21. Umbellules of some *Arthrophyllum* spp. a. *A. ahernianum* MERR., b. *A. engganoense* PHILIPSON, c. *A. diversifolium* BL., d. *A. macranthum* PHILIPSON. All nat. size. — Bracts of two *Arthrophyllum* spp. e. *A. collinum* PHILIPSON, f. *A. crassum* PHILIPSON. Both  $\times \frac{1}{3}$  (Courtesy Gard. Bull. Sing. 30, 1977).

c. 3–6 cm long, articulated near the middle; pedicels c. 10, c. 2–3 mm long, rufous tomentose. Petals 5, broadly triangular, c. 2 mm long. Stamens 5, anthers curved. Ovary turbinate, rufous-tomentose, c. 1½ mm long at anthesis; disk fleshy, stigma sessile. Fruit ellipsoidal, c. 9 by 5 mm (when dry), the calyx and stylodipodium prominent.

Distr. *Malesia*: Borneo (Sarawak and Sabah).

Ecol. Forest and scrub, sometimes growing as an epiphyte in the crowns of trees, 600–2700 m.

Notes. The bark is grey and smooth, the wood pale and soft, and the cut stems exude a yellowish or orange latex.

This species is characterized by the rotund, coriaceous leaves on the flowering branches.

**7. *Arthrophyllum crassum* PHILIPSON, Gard. Bull. Sing. 30 (1977) 305, f. 18. — Fig. 21f.**

Sparingly branched shrub or small tree up to 8 m, occasionally epiphytic, all young parts with dense, rufous tomentum which persists on the

flowers and inflorescence. *Leaves* multijugate, up to 100 (or more) by 50 cm, occasionally with 4 leaflets inserted at some of the lower articulations; of the flowering branches smaller with fewer pinnae or more frequently unifoliolate; petiole up to 25 cm; petiolules 10–20 mm; leaflets elliptic, oblong or lanceolate, up to 24 by 7½ cm, coriaceous, margin strongly revolute, base cuneate to rounded, often oblique, apex narrowed to an acute often caudate apiculum, midrib prominent, lateral veins faint to obscure. *Inflorescence* a cluster of specialized leafy branches forming a terminal crown; main rays up to 70 cm, bearing an opposite pair (or rarely more pairs) of unifoliolate or (less frequently) pinnate leaves, often with flowering branches in their axils, and ending in a whorl of secondary rays, subtended by usually unifoliolate leaves; secondary rays up to 25 cm, bearing a pair of usually unifoliolate leaves with flowering branches in their axils, and terminating in compound umbellules; tertiary rays c. 10, c. 2–3 cm long, articulated near the middle; pedicels c. 12–14, c. 3–4 mm long, rufous-tomentose. *Petals* 5, broadly triangular, c. 2 mm long. *Stamens* 5, anthers curved. *Ovary* turbinate, rufous-tomentose, c. 1½ mm long at anthesis; disk fleshy, stigma sessile. *Fruit* spheroidal, c. 6 by 5 mm (when dry), calyx and stylopodium prominent.

*Distr. Malesia:* Borneo (Sarawak and Kalimantan).

*Ecol.* Swampy peat forest and heath woodland, both primary and disturbed, from sea-level to c. 150 m. Some fragmentary collections from higher altitude (1000 m) further inland may belong to this species.

*Note.* The leaves associated with the inflorescence are distinctively fleshy, have a strongly revolute margin and a smooth lower surface with indistinct lateral veins, and are ovate with rather acute apex. The leaflets of the pinnate leaves on the vegetative shoots are also rather leathery with indistinct lateral venation.

**8. *Arthrophyllum pacificum*** PHILIPSON, Gard. Bull. Sing. 30 (1977) 306.

A slender, glabrous tree to 14 m. *Leaves* multijugate, c. 60 by 24 cm; of the flower-bearing branches smaller with fewer pinnae or simple; petioles c. 22 cm, 3–4 mm Ø; petiolules c. 1 cm; leaflets elliptic, oblong or ovate, c. 8–10 by 4–5 cm, rather membranaceous, margin entire, very slightly revolute, base abruptly cuneate, often oblique, apex obtuse, acute, or slightly apiculate (in a specimen from Morotai attenuated). *Inflorescence* a whorl of specialized leafy branches forming a terminal crown to the vegetative shoots; main rays 35 cm, bearing small pinnate leaves in opposite pairs and with flowering branches in the axils, ending in a whorl of secondary rays, subtended by a whorl of simple leaves (bracts); secondary rays 10–24 cm long, bearing simple or trifoliolate leaves

usually in opposite pairs, and terminating in umbellules; umbellules c. 7–12-flowered; pedicels c. 5 mm at anthesis, slightly elongating in fruit, minute bracts caducous. *Petals* 5, broadly triangular, 2½–3 mm long. *Stamens* 5, anthers reniform. *Ovary* obconical, 1½ mm long; disk fleshy, furrowed when dry; stigma ± sessile. *Fruit* ellipsoidal, fleshy, somewhat oblique, conical beak with calyx and stigma, c. 9 by 5 mm when dry.

*Distr. E. Malesia:* Moluccas (Morotai) to the Bismarck Archipelago.

*Ecol.* Primary forest on mountain slopes, attaining *Nothofagus* mossy forest, 500–2000 m. Reported as common in most localities.

*Vern. Kainsoka*, Ambai, Japen I.

*Notes.* All specimens from islands to the north of New Guinea are similar, in having more delicate foliage than 10. *A. macranthum* from the mainland of New Guinea. The specimens from Morotai are sterile, and have narrower more tapering leaflets.

The bark is light brown and the cut branches exude a clear latex. The flowers are light green with yellow anthers, and the fruit is black.

**9. *Arthrophyllum diversifolium*** BL. Bijdr. (1826) 879; DC. Prod. 3 (1830) 266; MIQ. Fl. Ind. Bat. 1, 1 (1856) 767; Sum. (1861) 340, incl. var. *lanceolata* MIQ.; CLARKE, Fl. Br. Ind. 2 (1879) 733; K. & V. Bijdr. 7 (1900) 46; KOORD. Exk. Fl. Java 2 (1912) 717; Atlas 4 (1916) f. 675 & 676; BACK. & BAKH. f. Fl. Java 2 (1965) 169; STONE, Gard. Bull. Sing. 30 (1977) 135; PHILIPSON, l.c. 306, f. 15. — *A. javanicum* BL. Bijdr. (1826) 879; DC. Prod. 4 (1830) 266; BACK. & BAKH. f. Fl. Java 2 (1965) 169. — *A. ellipticum* BL. Bijdr. (1826) 879; DC. Prod. 3 (1830) 266. — *Mormorphis sumatrana* JACK ex WALL. Cat. (1831) n. 4931, nomen. — *A. blumeianum* Z. & M. Syst. Verz. (1846) 41, nom. illeg.; MIQ. Fl. Ind. Bat. 1, 1 (1856) 768; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 27, incl. var. *oblongatum* MIQ., var. *ellipticum* (BL.) MIQ. et var. *ovalifolium* (JUNGH. & DE VRIESE) MIQ. — *A. ovatifolium* JUNGH. & DE VRIESE, Ned. Kruidk. Arch. 1 (1846) 19; Ann. Sc. Nat. Paris III, 6 (1846) 117; MIQ. Fl. Ind. Bat. 1, 1 (1856) 768, t. 14 ('*ovalifolium*'); RIDL. Fl. Mal. Pen. 1 (1922) 885; STONE, Gard. Bull. Sing. 30 (1977) 136, f. 2. — *A. dilatatum* MIQ. Fl. Ind. Bat. 1, 1 (1856) 768. — *A. borneense* BAKER, Kew Bull. (1896) 23; MERR. En. Born. (1921) 457. — *A. congestum* RIDL. J. Fed. Mal. St. Mus. 10 (1920) 137; Fl. Mal. Pen. 1 (1922) 887; STONE, Gard. Bull. Sing. 30 (1977) 136. — *A. havilandii* RIDL. Kew Bull. (1933) 494. — *A. rufosepalum* RIDL. Kew Bull. (1946) 40. — *A. rubiginosum* RIDL. l.c. 41. — Fig. 17, 21c, 22, 23.

Small tree, up to 14 m, young parts with rufous tomentum. *Leaves* clustered at the ends of the branches, imparipinnate or bipinnate (rarely tripinnate) with leaflets at the insertion of the lateral rachides, multijugate, 150 by 45 cm (wider in bipinnate leaves); usually in opposite pairs on





Fig. 22. *Arthrophyllum diversifolium* BL. Diagrammatic sketch of habit, showing vegetative and flowering branches,  $\times \frac{1}{30}$  (Courtesy Gard. Bull. Sing. 30, 1977).

the inflorescence-bearing branches and smaller with fewer pinnae or unifoliolate; petiole up to 40 cm; petiolules  $\frac{1}{2}$ – $1\frac{1}{2}$  cm; leaflets ovate-oblong or elliptic, up to 24 by 11 cm (leaflets of bipinnate leaves usually c. 10 by 5 cm), = coriaceous or (especially in bipinnate leaves) somewhat membranaceous, margin slightly revolute, base truncate, rounded, or cuneate, often oblique, apex shortly acuminate, veins usually 5–7 pairs. *Inflorescence* a cluster of specialized leafy branches forming a terminal crown which abscises after fruiting; main rays up to 150 cm, bearing pinnate (or more

rarely unifoliolate) leaves mostly in opposite pairs and usually with flowering branches in the axils of the upper leaves, ending in an umbel of secondary rays subtended by a whorl of pinnate or unifoliolate leaves; secondary rays up to c. 30 cm, bearing mainly simple leaves in opposite pairs with flowering branches in their axils and terminating in compound umbellules each subtended by a whorl of often caducous bracts; tertiary rays (peduncles) c. 5 cm, articulated about the middle; umbellules with c. 30–40 flowers, c. 17–20 mm  $\varnothing$ ; pedicels c. 20, c. 5 mm at anthesis (longer in fruit),



Fig. 23. *Arthrophyllum diversifolium* BL. Schematic drawing of a single flowering shoot, with four degrees of branching,  $\times \frac{1}{5}$  (Courtesy Gard. Bull. Sing. 30, 1977).



with an involucre of minute caducous bracts. Petals 5, c. 2 mm long. Stamens 5, anthers curved. Ovary turbinate, often inconspicuous at anthesis; disk fleshy, rising in the centre to a sessile stigma. Fruit ellipsoidal, c. 9 by 7 mm; calyx and stylopodium forming a conspicuous beak.

Distr. *Malesia*: Sumatra, Malay Peninsula, Java, Borneo, Celebes.

Ecol. In a wide variety of habitats, on dry sandy soil to swampy humus, in primary lowland and montane rain-forest and also in secondary forest, heath-forest and waste land, from sea-level to 1600 m.

Uses. Concoctions of the root and bark are reported to have medicinal properties, including a remedy for syphilis, and the plant has stupifying and poisonous properties.

Vern. Sumatra: *antjaneudeung uding, bidju, bolu bolu, bulu, (kayu) abang-abang, k. attu turut, lëgung*, Riouw Arch., *mapang, miu, obang, potah, silanta, tējam dakan*, Banka, *tocrah*. Malay Peninsula: *chindangan utan, jolok hantu, lupa dahan, (pokok) restong, sēgan budahan, susun kēlapa, tum bong ninyor, tusum perpah*. Java: *dajo, dēlahan, dēleg, dēlek, djangkorrang, gombong, (kayu) gompang, kēdrja, kidjangkurang, kingompang, ki ompong, klēntjang, krēpang, langitj, malas bērdahan, pongporang, putjangan*. Borneo: *merjemeh, Sarawak, karadjungjung*, Kalimantan. Celebes: *kambabah, susangkangan*.

Notes. The very widespread *A. diversifolium* is variable in many characters, and may comprise a number of geographic subspecies, but no basis for this is apparent at present. Most individuals have the lower leaves simply imparipinnate, whereas others have bipinnate, or rarely tripinnate, leaves. The flowers and inflorescences of these forms appear to be identical, though rapid changes in the umbellules after flowering produce a deceptively distinctive appearance in specimens at different stages of development. Field experience over the whole range of the species will be required to understand this interesting leaf-polymorphism. In treating all forms as one species I am partly influenced by the fact that most authors who have been familiar with the plants in Java (where both forms occur) have regarded the complex as a single species (the fact that some authors have recognized the variant from Mt Salak as a distinct species does not affect the problem of leaf-polymorphism).

Apart from the strikingly different leaf forms just discussed, certain local variants may eventually be shown to justify specific rank. A form growing on Mt Salak (near Bogor) has often been regarded as distinct (see, for example, HOCHREUTNER, Candollea 2, 1925, 481, and BACKER & BAKHUIZEN VAN DEN BRINK f. Fl. Java 2, 1965, 169). Indeed this form is the basis of the name *A. diversifolium*. I retain this name in preference to the other two names published simultaneously by BLUME because it has been most consistently adopted since

it was first used in this comprehensive sense by CLARKE, l.c. On the evidence available I do not consider the Salak plants any more distinctive than many other local variants.

It might be considered that 5. *A. engganoense* is also no more than another such variant, but its facies is so marked that specific rank appears justified.

It is possible that RIDLEY was correct in distinguishing *A. congestum*, but the material is not good and appears inadequate to confirm specific status.

Five collections from Brunei and a neighbouring district of Sarawak are all very alike and sufficiently distinct from both *A. diversifolium* and 7. *A. crassum* to suggest that they represent a separate taxon, but for the present they are tentatively retained as a form of *A. diversifolium*.

Similarly, the two collections described by RIDLEY as *A. rubiginosum* and *A. rufosepalum* are based on collections which are not altogether typical of *A. diversifolium*, but which come closest to that species. In the absence of more supporting material, it is advisable not to retain them as species. The first of these names (*A. rubiginosum*) has been widely used in identifications of Bornean specimens, but the specimens concerned are either typical *A. diversifolium* or belong to the distinctive 7. *A. crassum*.

Specimens from Mt Kinabalu described by RIDLEY as *A. havilandii* have bipinnate leaves, and appear to conform well with *A. diversifolium*. This form was again collected on Mt Kinabalu by CLEMENS and is also known from Sarawak.

The smooth bark is whitish to greyish brown with pustulate lenticels; the wood is cream, with a colourless aromatic exudate. The flowers are yellowish with a sickly sweet scent. Seedlings have simple and trifoliate leaves.

**10. *Arthrophyllum macranthum* PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 18; Gard. Bull. Sing. 30 (1977) 308, f. 16. — *A. diversifolium* (non BL.) HARMS, Bot. Jahrb. 56 (1920) 413. — Fig. 21d.**

Tree up to 25 m, sparsely branched with leaves crowded at the ends of the branches, all young parts with dense rufous tomentum which may persist on the flowers and inflorescence. Leaves multijugate, up to 100 by 30 cm; of the flower-bearing branches smaller with fewer pinnae, or simple; petioles stout, up to 40 cm, clasping base heavily lenticellate; petioles  $\frac{1}{2}$ –2 cm; leaflets ovate to oblong, up to 16 by 8 cm, coriaceous, margin revolute, base rounded, truncate, or cordate, very rarely cuneate, often oblique, apex obtuse or bluntly apiculate, principal veins arched-ascending, reticulations visible especially beneath (pinnae of leaves on the flowering branches usually elliptic with a cuneate base). Inflorescence a whorl of specialized leafy branches forming a terminal crown; main rays up to 60 cm, bearing pinnate leaves often in opposite pairs and with flowering

branches in the upper axils, and ending in a whorl of secondary rays subtended by a whorl of usually simple leaves (bracts); the secondary rays c. 10–20 cm, bearing simple leaves, usually in opposite pairs, and terminating in compound umbels; umbellules (c. 2 cm) with c. 10–15 flowers; pedicels stout, 3–5 mm to 10 mm or more in fruit, subtended by minute bracts. *Flower buds* 5 mm or more long; calyx a rim or with 5 indistinct teeth. Petals 5, triangular, c. 4 mm long, fleshy. Stamens 5. Ovary obconical, c. 2½ mm long; disk fleshy (hemispherical in living material, conical and furrowed when dry); stigma capitate, ± sessile. *Fruit* ellipsoid, sometimes slightly oblique, c. 12 by 8 mm, the stylopodium forming a conical beak with the persistent stigma; exocarp fleshy, endocarp cartilaginous.

Distr. *Malesia*: New Guinea (from Irian Jaya to Milne Bay Distr. and the Bismarck Archipelago).

Ecol. Usually a sub-canopy tree of rain-forest ranging from the lower montane zone to mossy subalpine woodland and scrubland, occasionally in second growth, usually above 1000 m (up to 2700 m), but occurring also on the coastal scarps of the Astrolabe Range.

Vern. *Maguva*, W. Sepik, *agagwa*, *agare*, *agugwa*, *alolo*, *angga*, *engga*, *pooi*, *tipilan*, W. Highlands, *aru*, *hagegoa*, *wonkurumeh*, E. Highlands, *kolom*, S. Highlands.

Note. Trees become very different in appearance when in flower or fruit: the spiral pinnate foliage leaves are surmounted by tufts of branches which end in inflorescences and bear much smaller leaves. The foliage leaves are fleshy, leathery and glossy. The ripe fruit is purple and shining. The bark is grey, at first smooth with many leaf-scars and lenticels, but small longitudinal fissures develop. The cut branches exude a brown latex and a scent of celery. The soft wood is white or straw-coloured.

**11. *Arthrophyllum papyraceum*** PHILIPSON, Gard. Bull. Sing. 30 (1977) 308.

Shrub, rufous-tomentose on the young parts. *Leaves* alternate, imparipinnate; petiole 15–20 cm; leaflets c. 7, membranaceous, elliptic, c. 12–24 by 5–10 cm, base broadly cuneate, apex finely acuminate, margin slightly revolute. *Inflorescence* a terminal compound umbel; primary rays few (2), 2–3 cm long, 2 mm wide, without bracts (caducous), secondary rays few (3), c. 13–18 mm long, articulated about the middle, ending in an umbellule of c. 10–12 flowers; pedicels 2–3 mm, slightly furfuraceous. Petals 5, c. 2 mm long in bud. Stamens 5, anthers curved. Ovary turbinate, glabrous, obscurely ribbed. Fruit unknown.

Distr. *Malesia*: E. Sumatra (East Coast Res. near Aek Sordang), one collection.

Ecol. Primary rain-forest.

Note. Known from a single collection (with no duplicates) this species resembles 12. *A. maingayi* in its simple inflorescence, and the few pinnae of its

foliage leaves. However, the large size of the leaflets precludes its inclusion in that species.

**12. *Arthrophyllum maingayi*** PHILIPSON, Gard. Bull. Sing. 30 (1977) 309, f. 7. — *A. pinnatum* CLARKE, Fl. Br. Ind. 2 (1879) 734, excluding synonyms [see also SEEM. J. Bot. 4 (1866) 294]; RIDL. Fl. Mal. Pen. 1 (1922) 886. — Fig. 19c, 20a.

Low shrub or slender tree, rarely as high as 10 m, rufous-tomentose on the very young parts, soon becoming glabrous. *Leaves* tufted at the ends of the branches, usually with 5–7 leaflets (but up to 15), up to 30 by 18 cm; petiole to 12 cm (usually shorter), 2 mm Ø; petiolules c. 0–10 mm; leaflets elliptic or elliptic-lanceolate (occasionally the lowermost pair of leaflets is replaced by pinnate leaf segments), c. 8 by 3½ cm, rather thin, base cuneate or rounded, apex apiculate or caudate, margin slightly revolute, lateral veins faint and obscure; leaves below the flowering branches sometimes reduced to 3 or 1 leaflet(s). *Inflorescence* consisting of a number of primary branches radiating from the end of a leafy shoot (which forms a longer or shorter peduncle); primary branches, often rather few, usually 3–6 cm long and devoid of leaves except for a few terminal simple or trifoliate leaves around the compound umbels, occasionally the branches bear pairs of opposite leaves when they may be up to 30 cm long; secondary rays c. 2–3 cm long; pedicels 4–10 cm. Petals 5, 1½–2 mm long in bud. Stamens 5. Ovary turbinate, disk fleshy. *Fruit* spheroidal, c. 8 by 6 mm, calyx and stylopodium rather inconspicuous.

Distr. *Malesia*: Central W. Sumatra (Mt Kerintji), throughout the Malay Peninsula (incl. Penang) and Borneo.

Vern. *Poko minta anak*, Kedah, *karon baru*, Sumatra.

Notes. The name '*A. pinnatum*', misapplied by CLARKE, l.c., has been in general use for this species. However, this name was based on *Panax pinnatum* LAMK, which in turn was based on the Rumphian name '*Scutellaria secunda*'; this is quite a distinct plant (see under 6. *Polyscias cumingiana*).

The three species *A. maingayi*, 16. *A. montanum* and 17. *A. alternifolium* are similar in having simpler inflorescences than 9. *A. diversifolium*.

*A. montanum* can be distinguished from *A. maingayi* by its more leathery leaves with more prominent nervation, and by the more woody and leafy flower-bearing primary branches of the inflorescence.

*A. alternifolium* is distinguished from both these species by its small, coriaceous leaflets with inconspicuous nervation.

Most specimens can be readily distinguished, but a few can be assigned to a species only doubtfully, usually because the material is inadequate. This is usually due to the junction between the vegetative (spiral phyllotactic) shoots and the flower-bearing branches being omitted.



**13. *Arthrophyllum kjellbergii* PHILIPSON**, Gard. Bull. Sing. 30 (1977) 309, f. 10. — **Fig. 20d.**

Small tree, 10 m, branches c. 1 cm  $\varnothing$ , young parts covered by rufous tomentum. *Leaves* clustered towards the ends of the branches, multijugate, 25–30 by 16 cm; petioles c. 8 cm, 2 mm wide; petiolules c. 3–8 mm; leaflets elliptic or ovate-oblong, up to 8 by  $3\frac{1}{4}$  cm, chartaceous, margin minutely revolute, base rounded to cuneate often oblique, apex tapered to a blunt apiculum, or rounded and mucronate. *Inflorescence* a terminal cluster of c. 5–10 specialized branches (primary rays); primary rays c. 15–20 cm,  $1\frac{1}{2}$ –2 mm wide, bearing near the middle an opposite pair of simple leaves or sometimes trifoliolate leaves with short flowering branches in their axils, and sometimes with a second pair higher up, and 2–3 similar leaves below the terminal cluster of secondary rays; secondary rays c. 12, c.  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm long, each subtended by a small bract and bearing opposite caducous bracts near the middle, terminating in an umbellule of c. 12 flowers surrounded by an involucre of caducous bracts (1 mm long). *Flowers* known only in young bud. *Fruit* spheroidal, c. 5 by 4 mm, calyx and stylopodium prominent; pedicel 5–6 mm.

Distr. *Malesia*: SE. Celebes (Kendari).

Ecol. Primary rain-forest, 50–150 m.

Note. The small leaves and relatively simple inflorescences are distinctive.

**14. *Arthrophyllum cenabrei* MERR.** Philip. J. Sc. 20 (1922) 417; En. Philip. 3 (1923) 235; PHILIPSON, Gard. Bull. Sing. 30 (1977) 309.

Glabrous tree, c. 10 m, ultimate branches c. 5 mm  $\varnothing$ . Upper *leaves* pinnate, up to 10 cm long, leaflets mostly 5, sometimes 3, or the uppermost reduced to simple leaflets, the rachis and petiole c. 4 cm; leaflets mostly elliptic,  $4\frac{1}{2}$ –6 by  $2\frac{1}{2}$ – $3\frac{1}{2}$  cm, chartaceous to subcoriaceous, very shortly and obtusely acuminate, base acute, brownish olivaceous and slightly shining when dry, nerves 3–4 pairs, slender; petiolules 5–10 mm. Peduncles c. 4 cm, umbellately arranged at the tops of the branchlets, usually however with solitary inflorescences in the axils of the uppermost leaves, thus forming a somewhat leafy inflorescence. *Fruits* 5–8 in each umbel, ovoid, c. 7 mm  $\varnothing$ ; pedicels 8–10 mm.

Distr. *Malesia*: Philippines (Cebu; FB 28343, type, not seen).

Ecol. On slopes at 600 m.

Vern. *Bingliu*, C.Bis.

Note. No specimen of this species has been located. The above description is taken from MERRILL's original account. In placing this species in the key, it has been assumed that the inflorescence branching is relatively simple.

**15. *Arthrophyllum pulgarens* ELMER**, Leaf. Philip. Bot. 7 (1915) 2551; MERR. En. Philip. 3 (1923) 235;

PHILIPSON, Gard. Bull. Sing. 30 (1977) 311, f. 9. — **Fig. 20c.**

Small tree, branches c. 1 cm  $\varnothing$ , young parts with red tomentum, becoming glabrous except on the ovaries. *Leaves* clustered towards the ends of the branches, leaflets c. 6 pairs, c. 22 by 8 cm; petioles c. 6 cm, 3 mm  $\varnothing$ ; petiolules 5–6 mm; leaflets elliptic to rotund, c. 4 by  $2\frac{3}{4}$  cm, coriaceous, margin revolute, rounded to broadly cuneate, apex rounded or abruptly tapered to a short obtuse apiculum. *Inflorescence* a terminal cluster of specialized branches (primary rays); primary rays c. 6–10 cm, 3–4 mm  $\varnothing$ , bearing near the middle an opposite pair of simple rotund leaves, sometimes with flowering branches in their axils, and with a whorl of similar leaves below the terminal cluster of secondary rays; secondary rays c. 6–8, 2–4 cm long, articulated about the middle with scars of bracts or bearing a pair of small simple leaves terminating in an umbellule of c. 8–12 flowers; bracts caducous. *Calyx* with indistinct teeth. Petals 6,  $2\frac{1}{2}$  mm long (in bud). Stamens 6, anthers curved. Ovary obconical, 2 mm long, furfuraceous. *Fruit* ellipsoid, c. 8 by 5 mm, the stylopodium forming a beak with stigma and calyx; exocarp fleshy.

Distr. *Malesia*: Philippines (Palawan: Mt Pulgar).

Ecol. Common in montane forest on Mt Pulgar.

Note. The coriaceous, small, often rotund leaflets are characteristic.

**16. *Arthrophyllum montanum* RIDL**. J. Fed. Mal. St. Mus. 4 (1909) 24; Fl. Mal. Pen. 1 (1922) 886; PHILIPSON, Gard. Bull. Sing. 30 (1977) 311, f. 8. — *A. nitidum* RIDL. J. Fed. Mal. St. Mus. 7 (1916) 42; Fl. Mal. Pen. 1 (1922) 886. — *A. ovatum* RIDL. J. Fed. Mal. St. Mus. 7 (1916) 42; Fl. Mal. Pen. 1 (1922) 886. — **Fig. 19d, 20b.**

Shrub or small tree to 6 m, unbranched or sparingly branched, rufous-tomentose on the young parts, becoming glabrous. *Leaves* tufted at the ends of the branches, multijugate, c. 30–55 by 12–22 cm; petiole 9–21 cm, 3 mm  $\varnothing$ ; petiolules c. 10–15 mm; leaflets elliptic or oblong, 6–10 by  $2\frac{1}{2}$ –4 cm, coriaceous or chartaceous, base cuneate, apex with a short blunt apiculum, margin entire, revolute, the few principal lateral veins usually rather prominent; the leaves associated with the umbels usually unifoliolate, broadly elliptic to rotund, with a petiole to  $4\frac{1}{2}$  cm. *Inflorescences* on specialized leafy branches either in terminal clusters or axillary in the upper leaves; branches 10–30 cm, leaves mostly simple in opposite pairs, usually without flowering branches in their axils, branches ending in a whorl of simple leaves surrounding a compound umbel; primary rays c. 5–15(–20), 2–6 cm, with scars of caducous bracts; pedicels 4–8 mm. Petals (4–)5, 2 mm long in bud. Stamens (4–)5. Ovary turbinate; disk fleshy, stigma  $\pm$  sessile. *Fruit* spheroidal, c. 8 by

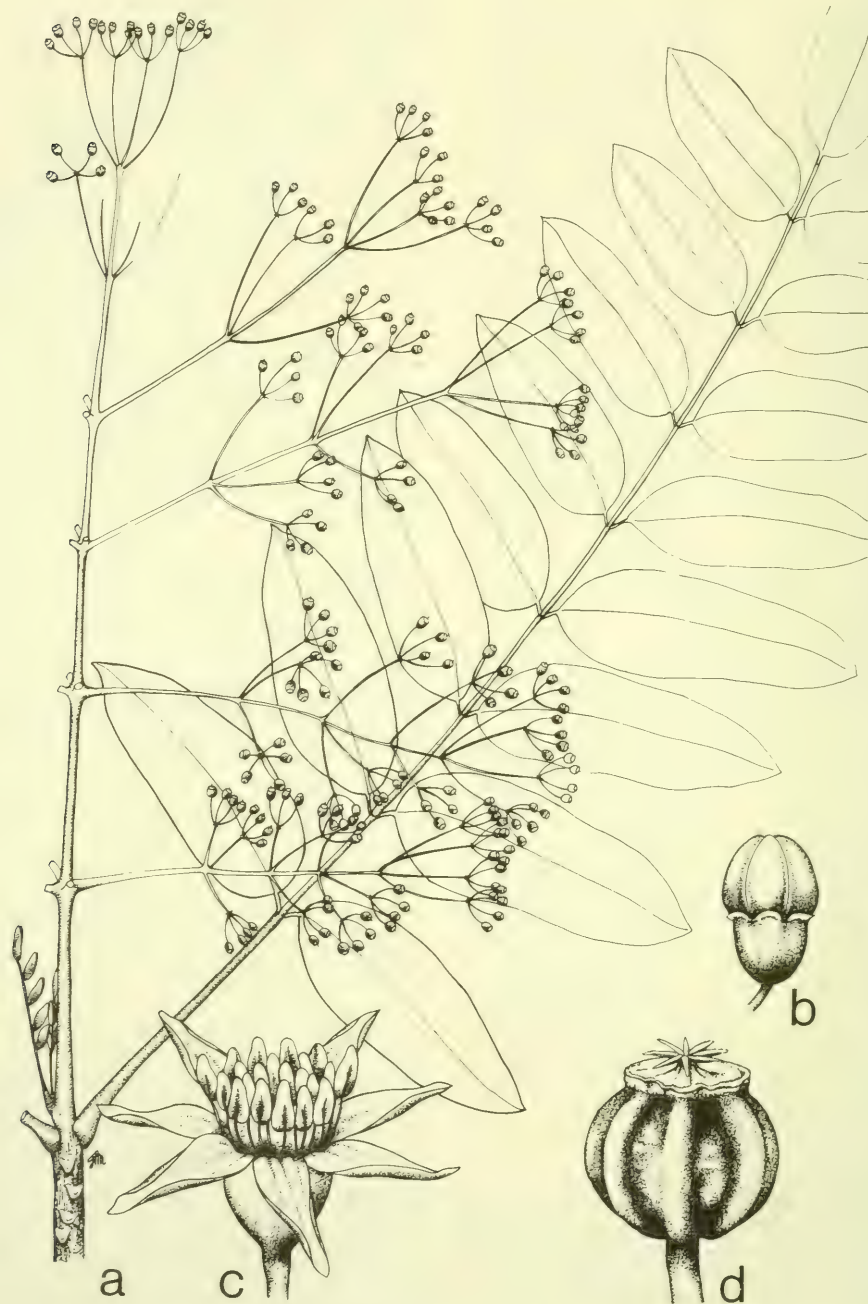


Fig. 24. *Gastonia serratifolia* (Miq.) PHILIPSON. a. Habit,  $\times \frac{1}{3}$ , b. lower bud, c. flower, d. fruit, both  $\times 5$  (a-c SCHMUTZ 3612, d VAN ROYEN 4090). Drawn by HELENE MULDER.



5 mm, calyx and stylopodium rather prominent.

Distr. *Malesia*: Malay Peninsula (Kedah to Selangor).

Ecol. Primary forest ascending to the montane zone, and in second-growth, 250–1500 m.

Note. Similar to 12. *A. maingayi* but distinguished by the more leathery leaves and by the leafy inflorescence branches which are usually absent in *A. maingayi*.

**17. *Arthrophyllum alternifolium* MAINGAY** *ex* RIDL. Fl. Mal. Pen. 1 (1922) 886; PHILIPSON, Gard. Bull. Sing. 30 (1977) 311, f. 11. — *A. pinnatum* CLARKE, Fl. Br. Ind. 2 (1879) 734, *p.p.*, *excl. basionym*; KING, J. As. Soc. Beng. 67, ii (1898) 59, *p.p.* — *A. alternifolium* MAINGAY *ex* CLARKE, Fl. Br. Ind. 2 (1879) 734, *nomen in synon.* — **Fig. 20e.**

Slender, sparingly branched shrub to 2 m, rufous-tomentose on the young parts, becoming glabrous. *Leaves* tufted at the ends of the branches, multijugate, *c.* 20–25(–30) by 9–12(–15) cm; petiole terete, *c.* 3–6(–9) cm, 2–3 mm  $\varnothing$ ; petiolules *c.* 2 mm; leaflets ovate, elliptic or lanceolate,  $3\frac{1}{2}$ –4(–6) by 1–2(–2 $\frac{1}{4}$ ) cm, coriaceous, base cuneate, apex acuminate to caudate, obtuse, margin revolute, veins obscure; leaves associated with the umbels (if any) reduced, with fewer leaflets or unifoliate, sometimes broadly ovate. *Inflorescence* usually a terminal compound umbel, occasionally a whorl of leafy branches (5–14 cm long) (leaves usually simple in opposite pairs), each

ending in a compound umbel; peduncle  $1\frac{1}{2}$ –4 $\frac{1}{2}$  cm, with one or more usually caducous simple (or trifoliate) leaves at the apex; primary rays *c.* 5, 3–4 $\frac{1}{2}$  cm, with scars of caducous leaves about the middle, each ending in an umbellule of *c.* 12–25 flowers, pedicels 5–8 mm. *Calyx* a rim or minutely 4–5-dentate. Petals 4–5, 2 mm long in bud. Stamens 4–5. Ovary turbinate; disk fleshy, stigma  $\pm$  sessile. *Fruit* spheroidal, *c.* 5 by 5 mm when dry, calyx and stylopodium small.

Distr. *Malesia*: Malay Peninsula (Johore: Mt Ophir; Pahang, Selangor, and Malacca).

Ecol. In shady montane forest, with *Rhododendron* and *Dacrydium*, 900 m and above.

Note. The small, coriaceous, often apiculate leaflets are characteristic. Although collected most frequently on Mt Ophir it occurs on other high ridges in southern Malaya.

#### Excluded

*Arthrophyllum ceylanicum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 27 (type in L), is according to VAN STEENIS, Rec. Trav. Bot. Néerl. 24 (1927) 819 = *Oroxylum indicum* (L.) KURZ (*Bignoniaceae*).

*Arthrophyllum reticulatum* BL. *ex* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 27 (type in L), is according to MIQUEL (*l.c.* 318) and VAN STEENIS (*vide supra*) = *Oroxylum indicum* (L.) KURZ (*Bignoniaceae*).

### 9. GASTONIA

COMM. *ex* LAMK, Encycl. 2 (1786) 610; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 5; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 43; HUTCH. Gen. Fl. Pl. 2 (1967) 68; PHILIPSON, Blumea 18 (1970) 491, 497, f. 1–10. — *Tetraplasandra* (non A. GRAY) MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 4; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 29, *p.p.*; Nachtr. 2 (1900) 253. — *Indokingia* HEMSL. in Hook. Ic. Pl. (1906) t. 2805. — *Peekeliopanax* HARMS, Notizbl. Berl.-Dahl. 9 (1926) 478, fig. — **Fig. 24, 26, 27.**

Trees unarmed with thick branches, glabrous or tomentose. *Leaves* large, imparipinnate, exstipulate; rachis articulated; leaflets in pairs entire or crenate; petiole terete, with clasping base. *Flowers* in umbellules which are arranged racemously, or in verticils, on strong inflorescence branches; pedicels not articulated below the ovary. *Calyx* forming a continuous rim with an entire or indistinctly denticulate margin. Corolla of 5–13 free petals or calyptrate, fleshy, valvate. *Stamens* either equal in number to the petals or up to several times as many; filaments usually rather short and thick; anthers large, often irregularly lobed, dorsifixed. Ovary inferior, broadly obconic, cells 7–22; disk fleshy with stylar processes equal in number to the cells arising from its centre. *Fruit* a spherical berry (strongly ribbed when dry), with an indistinct calyx rim, a flattened disk, and a

prominent stylopodium bearing a ring of radiating stigmatic arms; exocarp fleshy, endocarp crustaceous. Endosperm with smooth surface.

Distr. About 10 *spp.* in East Africa, Madagascar, the Seychelles and Mascarenes, *Malesia*, and the Solomon Is.

Ecol. Primary and second-growth forest, or in open country, from sea-level to lower montane zone.

Taxon. I have amply analyzed and discussed the affinities of *Gastonia* (Blumea 18, 1970, 497). I have come to the conclusion that within its alliances *Gastonia* is the only genus west of Samoa; in Polynesia there are three other closely allied genera.

#### KEY TO THE SPECIES

1. Corolla with free petals. Ovary cells and style arms 6–9(–12). Whole plant glabrous. Leaflets usually entire or sparsely crenate. Main inflorescence branches borne along an elongated axis with caducous bracts; peduncles of the umbellules mostly aggregated into pseudo-whorls . . . . . 1. *G. serratifolia*
1. Corolla calyptrate. Ovary cells and style arms 12–18(–22). Young parts with scurfy tomentum, persisting on the ovary and bracts. Leaflets strongly crenate. Main inflorescence branches borne sub-umbellately on a short axis with persistent bracts; peduncles of the umbellules scattered . . . . . 2. *G. spectabilis*

1. *Gastonia serratifolia* (MIQ.) PHILIPSON, *comb. nov.* — *Arthrophyllum serratifolium* MIQ. Sum. (1861) 341, type from Sibolga, leg. TEYSMANN (in U). — *G. papuana* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 5; HARMS, Bot. Jahrb. 56 (1921) 408; PHILIPSON, Blumea 18 (1970) 492, 500 f. 3. — *Tetraplasandra paucidens* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 4; KOORD. Minäh. (1898) 488. — *G. eupteronoides* T. & B. Nat. Tijds. N. I. 25 (1863) 416. — *Polyscias papuana* (MIQ.) SEEM. J. Bot. 3 (1865) 181. — *Tetraplasandra koordersii* HARMS, Ann. Jard. Bot. Btzg 19 (1904) 12; Ic. Bog. 2 (1906) t. 178. — *Tetraplasandra philippinensis* MERR. Philip. J. Sc. 1 (1906) Suppl. 219; En. Philip. 3 (1923) 222. — *G. winkleri* HARMS in Fedde, Rep. 15 (1917) 20. — *Tetraplasandra solomonensis* PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 11. — Fig. 24.

Shrub or small tree, sometimes epiphytic, up to 27 m, with clear bole to 15 m, dbh 34 cm, crown sparsely branched with leaves crowded at the ends of the branches, glabrous. Leaves up to 80 by 20 cm; petiole c. 13 cm; leaflets c. 10 pairs, petiolules up to 1 cm; blade oblong, ovate or lanceolate, middle leaflets 8–14(–18) by  $2\frac{1}{2}$ – $3\frac{1}{2}$ (–8) cm, chartaceous, entire and subrevolute, or with a few obscure, more rarely several prominent crenations, apex rounded and bluntly apiculate or tapering and acute, base broadly cuneate, midrib prominent. Inflorescence terminal, glabrous, with a stout primary axis 15–25 cm long, bearing scattered or clustered branches along its length and ending in an umbel of c. 10 branches; bracts caducous; secondary branches 30–40 cm, bearing numerous subverticillate peduncles along their length and ending in an umbel; peduncles c. 3 cm, somewhat longer in fruit; pedicels 1– $2\frac{1}{2}$  cm, forming umbellules of c. 10 flowers. Flower buds (when dry) c. 7 by 3 mm. Calyx rim

undulate. Petals 5–9, slightly fleshy, fully separated. Stamens variable in number, (7–)14–55; filaments short; anthers broad and irregularly lobed, variable in size. Ovary glabrous, smoothly rounded below, slightly constricted below the calyx; cells 6–12, usually c. 9, disk with a prominent rim and, at anthesis, a central boss formed by closely appressed subulate style arms equal in number to the ovary cells. Fruit c. 9 by 7 mm (without stylopodium), the flattened stylopodium ending in a ring or double row of radiating subulate stigmatic arms, black when ripe, the fleshy exocarp enclosing compressed crustaceous pyrenes.

Distr. Solomon Is.; in *Malesia*: Central W. Sumatra (Sibolga, Enggano I.), Malay Peninsula (Johore), Sunda Straits (islet Dwars in den Weg), West Java, Lesser Sunda Is. (Sumba, Timor, Wetar, Flores), W. Borneo (east of Pontianak, Karimata), N. Borneo (Sabah), Philippines

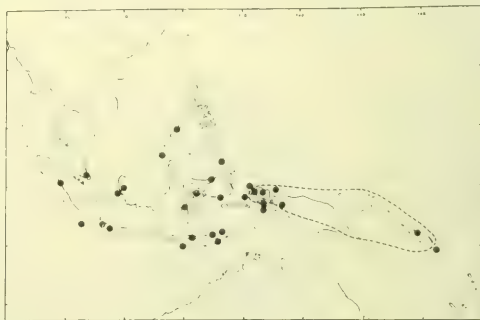


Fig. 25. Distribution of *Gastonia* in *Malesia*. Known localities of *G. serratifolia* (MIQ.) PHILIPSON: black dots; range of *G. spectabilis* (HARMS) PHILIPSON: broken line.





Fig. 26. *Gastonia spectabilis* (HARMS) PHILIPSON, two inflorescences visible below the leaves (Photogr. PHILIPSON, Kassam Pass, E. New Guinea, 1968).

(Palawan, Balabac), Celebes (Lepo-Lepo, Luwuk, Minahassa), N. Moluccas (Talaud Is.), New Guinea (Vogelkop, NW. & SW. Irian, Schouten I., Waigeu I.). Fig. 25.

Ecol. Primary and secondary forest, or in open country, usually at low altitude and often on the shore or sea-cliffs, but ascending to 1000 m. EYMA noted it to be a characteristic tree on Mt Tambunan, Luwuk, E. Celebes.

Vern. *Bajur talang èkoaho*, M, Enggano, *jarum*, Sabah, *raka*, Sumba, *kre*, *wangka*, Flores, *lampo paä*, *bungku*, Celebes, *buñgio*, Palawan, *lantora*, Talaud Is., *mansnongoree*, *mantsenongor*, Schouten I., *raauwrack*, *ara-orach*, Vogelkop, Maibrat.

Note. The entire or serrate nature of the leaf margins, the number of ovary cells, and especially the number of stamens are variable characters but show no discernable geographical segregation. The outer bark is described as light brown, with small oblong brittle scales. Inner bark, leaves and inflorescences with copious sticky juice. Wood soft white. The petals are variously described as purple, light green, and white.

2. *Gastonia spectabilis* (HARMS) PHILIPSON, *Blumea* 18 (1970) 494, pl. 1. — *Peekeliopanax spectabilis* HARMS, *Notizbl. Berl.-Dahl.* 9 (1926) 478, fig.; PHILIPSON, *Blumea* 18 (1970) 500 f. 2. — *G. bori-diana* HARMS, *Bot. Jahrb.* 69 (1938) 282. — Fig. 26, 27.

Tree up to 40 m high, clear bole to 28 m, dbh 1.75 m, crown sparsely branched with the branches whorled or regularly forked and the leaves crowded at the ends of the branches, all young parts with scurfy indumentum more evident in dried material. *Leaves* up to 80 by 30 cm; petiole c. 15 cm, with some tomentum remaining at the joints; leaflets c. 11 pairs on petiolules c. 2–8 mm, oblong or elliptic, middle leaflets 10–15 by 4–6 cm, chartaceous when dry, prominently crenate, apex narrowed to a short blunt apiculus, base rounded or truncate. *Inflorescence* in forks well below the leaves, when in bud covered with large scurfy cataphylls, and when mature with radiating branches forming clusters c. 130 cm Ø. *Primary axis* short (5–10 cm) with persistent bracts; secondary branches numerous, radiating, up to 65 cm, bearing small, persistent, scurfy bracts and peduncles scattered along their length and clustered in a terminal umbel; peduncles c. 1½–5 cm; pedicels ½–1½ cm, forming umbellules of c. 5–12 flowers. Flower buds c. 8 by 5 mm when dry (fresh c. 12 by 8 mm). *Calyx* rim straight. Petals 6–12, very fleshy, incompletely separated (often splitting into c. 5 lobes). Stamens 25–66, often c. 35, filaments short; anthers broad and irregularly lobed, variable in size. Ovary with a short dense indumentum, smoothly rounded below, cells usually c. 16, very rarely fewer than 10, as many as 22; disk at anthesis with a prominent rim and a central boss formed by closely appressed subulate



Fig. 27. *Gastonia spectabilis* (HARMS) PHILIPSON. Young tree, free bole 19 m, 47 cm Ø, crown 10 m, longest leaves 2 m, not yet flowering (Photogr. G. PEEKEL, New Ireland, Uganda, 1940).

styles equal in number to the cells. *Fruit* c. 8 by 10 mm (dry and without stylopodium), the flattened disk with a prominent stylopodium ending in an elliptical ring of radiating subulate stigmatic arms; the fleshy exocarp enclosing compressed crustaceous pyrenes.

Distr. Solomon Is.; in *Malesia*: New Guinea (Vogelkop, NW. Irian, Papua New Guinea), Bismarcks, and New Ireland. Fig. 25.

Ecol. Primary and secondary rain-forest, and in cultivated areas, 200–2000 m.

Vern. *Amoriga*, *bekuak*, *djak*, *ntjier*, *tuju*, Vogelkop, *bohko*, *boinga*, *gabel*, *jamwa*, *mestic*, *sikoto*, *tubat*, *tumbala*, Madang Distr., *waki*, W. Highlands, *aita*, E. Highlands, *kuhuh*, Papua.

Note. Possibly the largest araliad known. The regular habit of branching results from the vegeta-



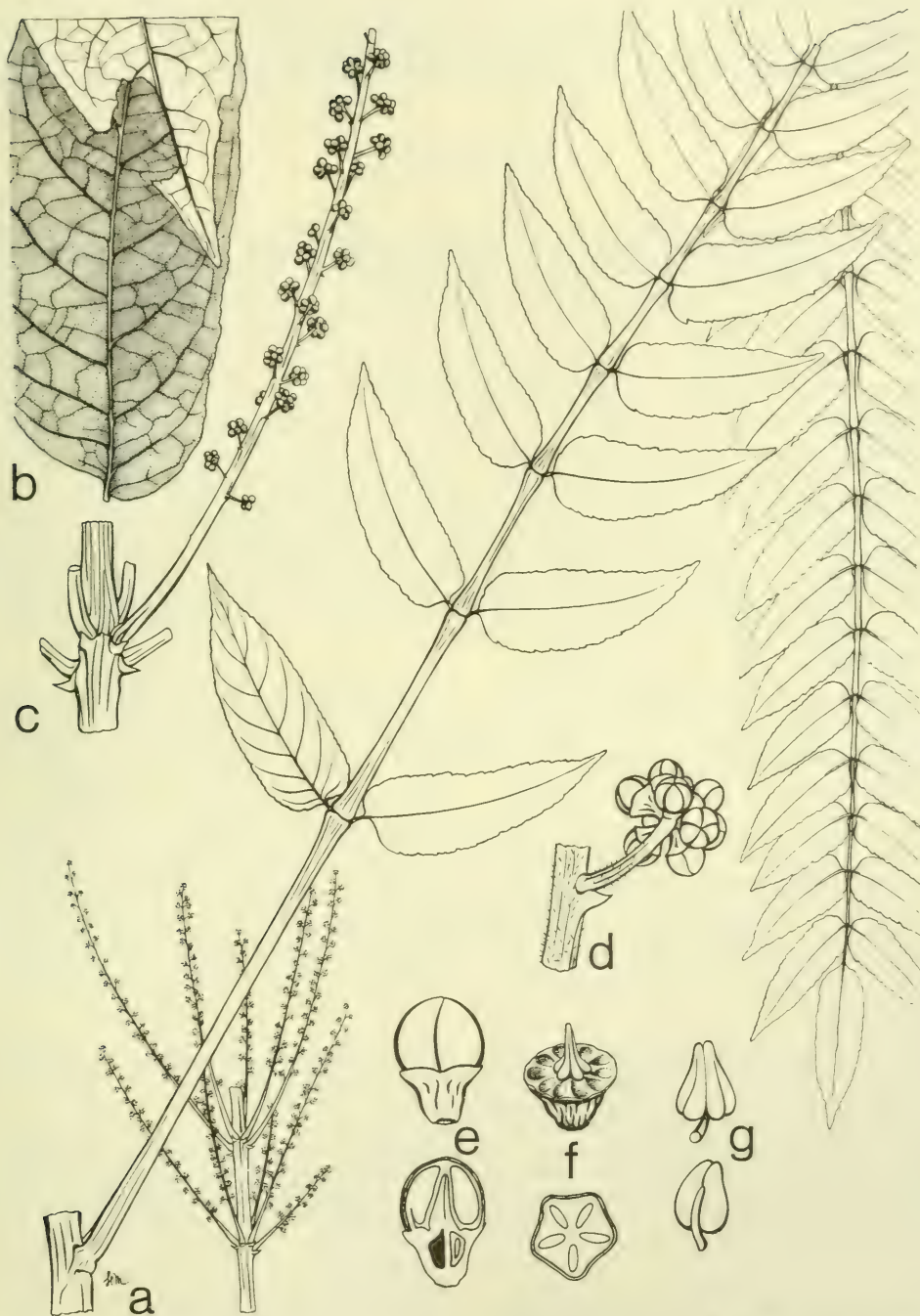


Fig. 28. *Polyscias nodosa* (BL.) SEEM. a. Leaf and part of inflorescence,  $\times \frac{1}{5}$ , b. leaflet,  $\times \frac{2}{3}$ , c. branch of inflorescence,  $\times \frac{2}{3}$ , d. umbellule, e. flower bud and ditto in LS,  $\times 8$ , f. ovary and ditto in CS,  $\times 8$ , g. stamens (VERSTEEGH BW 3868). Drawn by HELENE MULDER.

tive shoots springing in pairs or whorls from below terminal inflorescence buds. Several flushes of growth occur as an inflorescence bud matures, so that at anthesis the inflorescences are situated in forks well below the leafy crown, with a succession of younger inflorescence buds in higher forks.

Bole without buttresses or with buttresses 1 m high and 2 m wide. Outer bark brown with prominent pustular lenticels and small shallow fissures. Exudate from cuts abundant, clear and aromatic. Wood soft. Flowers cream, stamens yellow. Ripe fruit dark red-brown.

## 10. POLYSCIAS

J. R. & G. FORSTER, Char. Gen. (1776) 63, t. 32; DC. Prod. 4 (1830) 257; SEEM. J. Bot. 3 (1865) 179; BTH. in B. & H. Gen. Pl. 1 (1876) 941; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 43; KOORD. Atlas 4 (1916) f. 677–680; MERR. Int. Rumph. (1917) 408; HARMS, Bot. Jahrb. 56 (1921) 409; MERR. En. Philip. 3 (1923) 233; HUTCH. Gen. Fl. Pl. 2 (1967) 75; BERNARDI, Candollea 26 (1971) 13; PHILIPSON, Blumea 24 (1978) 169. — *Eupteron* MIQ. Pl. Jungh. 3 (1855) 423; Fl. Ind. Bat. 1, 1 (1856) 762; HUTCH. Gen. Fl. Pl. 2 (1967) 68. — *Nothopanax* MIQ. Pl. Jungh. 3 (1855) 425; Bonplandia 4 (1856) 139; Fl. Ind. Bat. 1, 1 (1856) 765; SEEM. Fl. Vit. (1866) 114; MERR. Int. Rumph. (1917) 409; En. Philip. 3 (1923) 233. — *Irvingia* F.v.M. Fragm. 5 (1865) 17, *non* HOOK. f. 1860. — *Kissodendron* SEEM. J. Bot. 3 (1865) 201; *ibid.* 6 (1868) 129; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45; Bot. Jahrb. 56 (1921) 412; HUTCH. Gen. Fl. Pl. 2 (1967) 75. — *Palmervandenbroekia* GIBBS, Arfak (1917) 162; HUTCH. Gen. Fl. Pl. 2 (1967) 75. — *Gelibia* HUTCH. Gen. Fl. Pl. 2 (1967) 57. — **Fig. 28, 30.**

Unarmed shrubs or trees, glabrous or furfuraceous. *Leaves* imparipinnate or 2–3-pinnate (rarely unifoliolate) with an elongated or short sheathing base; rachis articulated; petiole terete; leaflets in pairs, entire, crenate or dentate. *Inflorescence* terminal, often large, a panicle, corymb, or compound rarely simple umbel. *Flowers* in umbellules, capitula, or racemose; pedicels articulated below the ovary. *Calyx* a rim with an undulate or dentate margin. Petals 4–5 (–8 or more), valvate. *Stamens* equal in number to the petals; anthers dorsifixed. Ovary inferior, 4–5 (–8 or more)-celled; disk fleshy; styles either free and recurved (at least in fruit) or joined to form a beak-like stylopodium. *Fruit* a spherical or ovoid drupe, crowned by the persistent calyx rim and the styles or stylopodium; exocarp fleshy, endocarp chartaceous. Endosperm with an uneven surface, fissured, or rarely smooth.

Distr. About 100 spp. throughout the tropics of the Old World (incl. Australia), and the Pacific Islands; in *Malesia* 23 spp. of which 3 adventive: rare in West (none native in Sumatra and Malaya), more common in East, the majority in New Guinea. Fig. 29.

Ecol. Primary or second-growth forest, from sea-level to 2650 m.

Note. Araliads with pinnate leaves and an articulated pedicel are here regarded as forming one genus, divided into several sections. These sections have formerly been segregated as genera, but I follow BERNARDI, *l.c.*, in uniting them. The most distinctive is *sect. Polyscias*, characterized by an elongated leaf-sheath. Several of the species of this section are cultivated and have a number of cultivars.

### KEY TO THE SECTIONS

1. Leaf-sheath elongated, extending along the petiole for about  $\frac{1}{4}$  of its length (*Spp.* 1–7)

1. *Sect. Polyscias*

1. Leaf-sheath short or obsolete, restricted to the base of the petiole.

2. Style arms spreading, at least in fruit.



3. Flowers arranged racemously (*Sp.* 8) . . . . . 2. *Sect. Gelibia*  
 3. Flowers arranged in umbellules or capitula (*Spp.* 9–14) . . . . . 3. *Sect. Eupteron*  
 2. Style arms erect, fused, forming a beak in fruit.  
 4. Inflorescence large,  $\pm$  as long as the leaves (*Spp.* 15–19) . . . . . 4. *Sect. Kissodendron*  
 4. Inflorescence much shorter than the leaves (*Spp.* 20–23). . . . . 5. *Sect. Palmervandenbroekia*

### 1. Section Polyscias

PHILIPSON, *Blumea* 24 (1978) 169.

Aromatic, glabrous shrubs or small trees, often cultivated. Leaf-sheath elongated along the petiole for  $1/3$ – $1/4$  of its length. Styles spreading, at least in the fruit.

Distr. Polynesia, Queensland, *Malesia*, and SE. Asia.

#### KEY TO THE SPECIES

1. Leaves 2–3-pinnate. . . . . 1. *P. fruticosa*  
 1. Leaves imparipinnate, or unifoliolate.  
 2. Ovary 2-celled (or predominantly so).  
 3. Main inflorescence branches diffusely branched . . . . . 2. *P. macgillivrayi*  
 3. Main inflorescence branches with verticils of short branches . . . . . 3. *P. verticillata*  
 2. Ovary variable, but many flowers with more than 2 cells.  
 4. Leaflets orbicular or reniform. Leaves unifoliolate or trifoliolate . . . . . 4. *P. scutellaria*  
 4. Leaflets ovate, oblong, or elliptic (cultivated forms often lacinate or lanceolate). Leaves with 3 or more pairs of leaflets.  
 5. Leaf margin sharply serrate (blade often rhomboidal and variegated with light yellow) . . . . . 5. *P. guilfoylei*  
 5. Leaf margin entire, or obscurely dentate.  
 6. Peduncles of the ultimate umbellules bearing 1 or more pairs of small bracts (reduced flowering branches sometimes present in their axils) . . . . . 6. *P. cumingiana*  
 6. Peduncles of the ultimate umbellules either without bracts, or with 1 or more small bracts inserted singly . . . . . 7. *P. javanica*

1. *Polyscias fruticosa* (L.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45; K. & V. Bijdr. 7 (1900) 2; HARMS in K. Sch. & Laut. Fl. Schutzgeb. (1900) 486; KOORD. Exk. Fl. Java 2 (1912) 716; Atlas 4 (1916) f. 680; BAILEY, *Rhodora* 18 (1916) 153, *incl. var. plumata* (Hort.) BAILEY; BACK. & BAKH. f. Fl. Java 2 (1965) 168; PHILIPSON, *Blumea* 24 (1978) 169. — *Scutellaria tertia* RUMPH. Herb. Amb. 4: 78, t. 33. — *Panax fruticosum* LINNÉ, Sp. Pl. ed. 2 (1763) 1513; BL. Bijdr. (1826) 830; DC. Prod. 4 (1830) 254; BLANCO, Fl. Filip. ed. 2 (1845) 156; ed. 3, 1 (1877) 281, t. 78; CLARKE, Fl. Br. Ind. 2 (1879) 725; F.-VILL. Nov. App. (1880) 101; BOERL. Handl. 1 (1890) 647; F.v.M. Descr. Pap. Pl. 9 (1890) 60; WARB. Bot. Jahrb. 13 (1891) 396; KOORD. Minah. (1898) 488; MERR. Philip. J. Sc. 3 (1908) Bot. 84. — *Panax obtusum* BL. Bijdr. (1826) 880; DC. Prod. 4 (1830) 254. — *Aralia tripinnata* BLANCO, Fl. Filip. (1837) 223, *cf.* MERR. Sp. Blanc. (1918) 295. — *Nothopanax fruticosum* (L.) MIQ. Pl. Jungh. 3 (1855) 425; Fl. Ind. Bat. 1, 1 (1856) 765; SEEM. Fl. Vit. (1866) 114, 115; J. Bot. 4 (1866) 363; MERR. Fl. Manila (1912) 358, *incl. var. plumatum* (Hort.) MERR. *et var. victoricae* (Hort.)

MERR.; Int. Rumph. (1917) 410; Sp. Blanc. (1918) 295; HARMS, Bot. Jahrb. 56 (1921) 412; MERR. En. Philip. 3 (1923) 233; HEYNE, Nutt. Pl. (1927) 1209; OCHSE & BAKH. Veg. D.E.I. (1931) 64, f. 37; CORNER, Ways. Trees (1940) 150. — *Nothopanax obtusum* (BL.) MIQ. Fl. Ind. Bat. 1, 1 (1856) 766; SEEM. Fl. Vit. (1866) 114. — *P. obtusa* (BL.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45, *nom. illeg., non* BLANCO, 1837, *quae est Schefflera odorata* (BLANCO) MERR. & ROLFE; KOORD. Exk. Fl. Java 2 (1912) 716; Atlas 4 (1916) t. 679 S; BACK. & BAKH. f. Fl. Java 2 (1965) 168.

Glabrous shrub or small tree, up to 5 m, with branches bearing spirally arranged leaves towards their ends. *Leaves* tripinnate, variable in size to c. 75 cm long; petiole up to c. 25 cm, with a sheathing base to 5 cm long; pinnae to c. 25 cm long; leaflets shortly petiolate, very variable in shape and size, oblong or linear-lanceolate, or 1–12 by  $1/2$ –4 cm, more or less deeply serrate or lobed, or irregularly pinnatisect, apex attenuate, acuminate or rounded, base cuneate, truncate or subcordate, midrib and lateral veins evident. *Inflorescence* a diffuse panicle; primary axis up to c. 60 cm with

secondary branches mostly in verticils at intervals along its length; secondary branches up to 30 cm bearing umbellules in an irregularly branched system towards their extremities; umbellules with 12–20 flowers on pedicels *c.* 3 mm long. *Calyx* a minute rim. Petals 5, 2 mm long. Stamens 5. Ovary turbinate, *c.* 1 mm high, 2–3(–4)-celled; styles at first erect, later spreading. *Fruit* subglobose, fleshy, *c.* 5 mm  $\varnothing$  when dry.

*Distr.* Native country not properly known, cultivated throughout the region, and in other parts of the Indo-Pacific tropics.

*Ecol.* Grown at low and moderate altitudes (*c.* 1000 m) as an ornamental or hedge shrub and for culinary use.

*Vern.* (from various sources). Sumatra: *orang aring*, Medan, *kedongdong mekka*, Palembang; Malaya: *daun girang*, *siku kluang*, M; Java: *kedongdong alus*, *k. batur*, *k. laut*, M, *imba*, *kedongdong laki*, *k. tjina*, *randa nunut*, S, *tjakar kutjung*, *t. tjikri*, J, *kadongdung*, *k. laut*, *k. petèdhan*, Md; Celebes: *boka ula risé*, *kèndèm rintèk*, Minahasa, Alfur lang., *bombu*, Makassar; Philippines: *papúa*, Tag., Bik., *bani*, *makan*, Bik.; Moluccas: *daun papeda papua*, *pagar pagar*, Ambon, *guarbari*, *tampusong*, Ternate.

The name *kedongdong* belongs properly to species of the fruit tree genus *Spondias*, but is sometimes also applied to trees of other families with pinnate leaves; *papua* means 'curly'.

*Notes.* The foliage of this plant is extremely variable in size and form. Typical plants are figured by KOORDERS (1916, *l.c.*) and by OCHSE & BAKHUIZEN VAN DEN BRINK (*l.c.*). These may be readily identified by the intricately compound leaf.

The individual leaflets are characteristically ovate-lanceolate and serrate to deeply pinnatifid. However, broader leaflets with simpler outlines are not uncommon. The more rotund, blunter leaflets of *P. obtusa* are considered here to be an extreme form of this species (the type is bipinnate).



Fig. 29. Species density of *Polyscias* J. R. & G. FORSTER in Malesia; above the hyphen the number of endemic species, below it the non-endemics. Only the native species.

Occasional specimens have leaves so much reduced that they are simply pinnate or unifoliolate when they approach forms of 6. *P. cumingiana*.

A number of names have been applied to horticultural forms belonging to this section of the genus (*cf.* BAILEY, *Rhodora* 18, 1916, 153), but the interrelations of these will be understood only after intensive biosystematic study of the many cultivars.

**2. *Polyscias macgillivrayi* (SEEM.) HARMS** in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45; PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 14; Blumea 24 (1978) 169. — *Nothopanax macgillivrayi* SEEM. Fl. Vit. (1866) 114, *nomen*. — *Panax macgillivrayi* (SEEM.) BTH. Fl. Austr. 3 (1866) 382. — *P. grandifolia* VOLKENS, Bot. Jahrb. 31 (1901) 471; KANEHIRA, En. Micron. Pl. (1935) 385. — *Tieghemopanax macgillivrayi* VIGUIER, Bull. Soc. Bot. Fr. 52 (1905) 313. — *Polyscias sp.* C. T. WHITE, J. Arn. Arb. 10 (1929) 255.

Glabrous shrub or small tree, up to 15 m, with few branches bearing terminal clusters of large leaves. *Leaves* imparipinnate, up to 1 m (or more) long, uppermost leaves smaller; petiole *c.* 15 cm, with a sheathing base extending for 6–10 cm along the petiole; petiolules *c.* 10–15 mm; lamina oblong often broader near the base (lower and the terminal pinnules more ovate) *c.* 20–25 by 8–10 cm, slightly succulent when fresh, margin entire, revolute or occasionally minutely dentate, apex rounded and shortly apiculate, base rounded, truncate or subcordate, midrib and widely spaced laterals prominent. *Inflorescence* a large panicle; primary axis stout, rather short (*c.* 3–10 cm), often bearing reduced leaves or cataphylls basally, and a few lateral inflorescence branches, terminating in an umbel of long diffusely branched rays; lateral branches and rays *c.* 40–50 cm, with secondary branches *c.* 6–12 cm borne singly or in subverticils along their length; secondary branches with numerous tertiary branches bearing lateral and terminal umbellules (or the branching may be of a high order); umbellules with *c.* 6–12 flowers on delicate pedicels *c.* 3 mm long. *Calyx* a minute rim. Petals 5, 2½ mm long. Stamens 5, anthers oblong 1½ mm long, filaments delicate, 1½ mm long. Ovary turbinate in bud, 1½ mm long, rapidly becoming rotund, compressed with prominent veins, 2-celled; styles 2, divergent. *Fruit* fleshy, black, compressed, *c.* 5 by 6 mm; styles persistent, recurved.

*Distr.* Micronesia, Solomon Is., Queensland; in *Malesia*: New Guinea (Papua, Eastern and Milne Bay Distr.; Territory of New Guinea, Morobe Distr., Muli I.), also in the D'Entrecasteaux and Trobriand Is., New Britain, and Louisiades.

*Ecol.* Strand vegetation and littoral rain-forest, often behind mangrove.

*Vern.* *Aikove*, Mimific lang., *ane*, D'Entrecasteaux Is., *gambou*, Muli I., Morobe Distr., *nakaigwoo*, Trobriand Is., *raumonas*, Onjob lang.



3. *Polyscias verticillata* STONE, J. Arn. Arb. 47 (1966) 272, f. 1; PHILIPSON, Blumea 24 (1978) 169.

Glabrous, small tree to 7 m with few branches bearing spirally arranged leaves towards their ends. *Leaves* imparipinnate, up to 1 m long; petiole c. 24–30 cm, terete with a sheathing base c. 6–7 cm long; petiole 5–20 mm, leaflets oblong often broader near the base, c. 16–27 by 5–13 cm, margin entire, slightly revolute or sparsely denticulate, apex acuminate, base subcordate or truncate, often oblique, midrib and lateral veins evident. *Inflorescence* a large panicle; primary axis stout, rather short, with broad cataphylls, bearing several long radiating secondary branches in a sub-umbel; secondary branches c. 50 cm, with numerous tertiary branches borne in well defined verticils and in a terminal umbel, bracts triangular c. 8 mm long, caducous; tertiary branches c. 4–7 cm with small bracts near the middle; umbellules with c. 10–15 flowers, on pedicels 1–4 mm long. *Calyx* a minute rim. Petals 5, 2½ mm long. Stamens 5, anthers oblong, c. 1–1½ mm long. Ovary turbinate, c. 1 mm long, 2-celled; styles 2, at first erect, later recurved. *Fruit* globose, fleshy, black, compressed, c. 4 by 7 mm when dry; styles persistent.

Distr. Solomon Is.; in *Malesia*: New Guinea (New Britain, New Ireland, New Hanover, Admiralty Is., and Bagabag I.).

Ecol. Usually near the beach or in lowland forest, to 140 m.

Uses. The young foliage is eaten fresh or boiled.

Vern. *Babagula*, *valagur*, Kuana dial., *la bara kiku*, Nakanai, *tauwol*, Gasmata, *palu*, Vairamana, *veta vela*, Pomio.

Note. Cut surfaces produce a sweet scented sticky exudate. The petals are violet within, the fruits purple-black.

4. *Polyscias scutellaria* (BURM. f.) FOSB. Un. Hawaii Occ. Pap. 46 (1948) 9; STONE, Taxon 14 (1965) 284; PHILIPSON, Blumea 24 (1978) 169. — *Scutellaria prima* RUMPH. Herb. Amb. 4: 75, t. 31. — *Scutellaria secunda latifolia* RUMPH. l.c. 76. — *Crassula scutellaria* BURM. f. Fl. Ind. (1768) 78. — *Aralia cochleata* LAMK, Encycl. 1 (1783) 224. — *Panax scutellarioides* REINW. ex BL. Bijdr. (1826) 880; SPAN, Linnaea 15 (1841) 208. — *Panax cochleatum* (LAMK) DC. Prod. 4 (1830) 253; BOERL. Handl. 1 (1890) 647. — *Panax conchifolium* ROXB. Fl. Ind. ed. Carey 2 (1832) 77. — *Nothopanax cochleatum* (LAMK) MIQ. Pl. Jungh. 3 (1855) 425; Fl. Ind. Bat. 1, 1 (1856) 766; SEEM. J. Bot. 4 (1866) 296; Fl. Vit. (1866) 116; KOORD. Minah. (1898) 490; Exk. Fl. Java 2 (1912) 717; Atlas 4 (1916) f. 697. — *Nothopanax tricochleatum* MIQ. Fl. Ind. Bat. Suppl. (1860) 135, 340; MERR. Int. Rumph. (1917) 409; En. Philip. 3 (1923) 234; OCHSE & BAKH. Veg. D.E.I. (1931) 69, f. 39A. — *Panax rumphii* HASSK. Abh. Naturf. Ges. Halle 9 (1866) 220. — *Nothopanax scutellarium* (BURM. f.) MERR. Int. Rumph. (1917) 409; En. Philip. 3

1923) 234; HEYNE, Nutt. Pl. (1927) 1209; OCHSE & BAKH. Veg. D.E.I. (1931) 67, f. 39; CORNER, Ways. Trees (1940) 156; BACK. & BAKH. f. Fl. Java 2 (1965) 169. — *P. tricochleata* (MIQ.) FOSB. Phytologia 5 (1955) 290.

Glabrous shrub or small tree, up to 6 m, with branches bearing spirally arranged leaves towards their ends. *Leaves* simple or trifoliate, variable in size; petiole often c. 6 cm, but as long as 28 cm, with a sheathing base 1–6 cm long; lamina rotund or reniform, often c. 8 cm Ø but as wide as 28 cm, margin usually serrate or becoming sub-lobed towards apex, in larger leaves the serrations often inconspicuous, apex rounded, base ± cuneate, midrib and lateral veins evident. *Inflorescence* a diffuse panicle; primary axis usually long (up to 1 m) with secondary branches (mostly in verticils, at intervals along its length; secondary branches 15–30 cm, bearing umbellules in an irregularly branched system towards their extremities; umbellules with c. 8–16 flowers, on pedicels c. 3 mm long. *Calyx* a minute rim. Petals 4–5, 2 mm long. Stamens 4–5, anthers oblong, 1 mm long. Ovary turbinate, c. 1 mm high, (2–)3–4-celled, styles at first erect, later recurved. *Fruit* subglobose, fleshy, c. 5 mm Ø when dry.

Distr. Native country not properly known, possibly *East Malesia*; cultivated throughout the region, extending through the tropical Pacific.

Ecol. Grown at low and moderate altitudes (800 m) as an ornamental or hedge shrub.

Uses. The foliage is aromatic and is used to furnish perfume. Forms with variegated foliage are in cultivation. Used medicinally as a diuretic, against breast cancer, and to prevent baldness (HEYNE, l.c.). Also for culinary purpose (OCHSE & BAKH. l.c. 67).

Vern. Cf. HEYNE: *memangkakan*, (*pohon mangkok*, Mal. (after the dish (= *mangkok*)-shaped leaves which are in the Moluccas sometimes used as dishes); Java: *godong mangkokan*, M, *mama-mëkan*, S, *puring mangkok*, Md; Lesser Sunda Is.: *lanido*, *ndalido*, *ndari*, *ramido*, Roti; Celebes: (*daun*) *mangko*, *tuwo mangku*, M, *bobohang*, *boku ula*, *këndem wewënë*, *woworan*, Manado, *angko mangko*, Bug. & Mak.; Philippines: *salapiin*, Mindanao; Moluccas: *daun koin*, d. *papëda*, M, Ambon, *ai laun niwël*, *ai lohoi*, Alf., Ambon, *goma ma tari*, Gal., Halmahera, *sawoko*, Loda, Halmah., *rau paroro*, Ternate.

Note. This species is usually readily distinguished by its simple, orbicular, saucer-shaped leaves, but plants with some or all of their leaves trifoliate occur. STONE (Micronesica 2, 1965, 51) advanced evidence for uniting these trifoliate plants with *P. pinnata* (= 6. *P. cumingiana*) while retaining the unifoliate plants as a distinct species. Possibly all are forms of one polymorphous species complex, but here it is considered convenient to adhere to the view which unites all forms having

orbicular usually bowl-shaped leaves under the concept *P. scutellaria*.

**5. *Polyscias guilfoylei* (COGN. & MARCHÉ) L. H. BAILEY, Rhodora 18 (1916) 153; STONE, Micronesica 2 (1965) 57; PHILIPSON, Blumea 24 (1978) 169. — *Aralia guilfoylei* [BULL., Cat. (1873)] COGN. & MARCHÉ, Pl. Ornam. 2 (1874) t. 58. — *Nothopanax guilfoylei* (COGN. & MARCHÉ) MERR. Philip. J. Sc. 7 (1912) Bot. 242; Fl. Manila (1912) 357; En. Philip. 3 (1923) 234.**

Glabrous shrub to 3 m high, with few branches, bearing spirally arranged leaves towards their ends. *Leaves* imparipinnate, with 3–4 pairs of leaflets, c. 60 cm long; petiole c. 18 cm, terete, with a sheathing base 3–4 cm long; petiolules c.  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm; leaflets rotund, oblong or rhomboidal, c. 10–14 by 6–7 cm, rather thin and flaccid, sometimes rugose, margin sharply serrate to broadly cuneate (often decurrent on the petiole), often oblique, midrib and lateral veins evident. *Inflorescence* a diffuse panicle; primary axis short (c. 3–4 cm) with one or few lateral flowering branches, terminating in an umbel of long much-branched rays; lateral branches and rays c. 40–50 cm, with secondary branches (c. 5–8 cm) singly or mainly in subverticils along their length and in a terminal umbel; secondary branches with one or more pairs of small bracts and ending in umbellules with a few lateral tertiary branches also ending in umbellules; umbellules with c. 8–12 flowers on pedicels c. 8–10 mm long. *Calyx* a minute rim. *Petals* 5,  $2\frac{1}{2}$  mm long. *Stamens* 5, anthers oblong,  $1\frac{1}{2}$  mm long; filaments 2 mm. *Ovary* turbinate, c. 1 mm high, usually 3-celled, styles at first erect, but soon elongating and recurved. *Fruit* fleshy, globose, c. 4 by 5 mm.

*Distr.* Native country unknown, possibly from *East Malesia*. Cultivated throughout the region, but less commonly than other cultivated species of this section. General throughout the tropical Pacific.

*Ecol.* Usually grown as a hedge plant. Flowers only when left untrimmed or when growing as an escape from cultivation.

*Note.* Recognizable by the shape, texture and serrations of the leaflets, which are usually variegated with whitish or yellowish blotches near the margins. The flowers are brown in bud but yellow-green when open.

**6. *Polyscias cumingiana* (PRESL) F.-VILL. Nov. App. (1880) 102; PHILIPSON, Blumea 24 (1978) 169. — *Scutellaria secunda angustifolia* RUMPH. Herb. Amb. 4: 76, t. 32. — *Panax pinnatum* LAMK, Encycl. 2 (1788) 715, non *P. pinnata* J. R. & G. FORSTER, 1776; DC. Prod. 4 (1830) 254; SPAN. Linnaea 15 (1841) 208; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 15; BOERL. Handl. 1 (1890) 647; KOORD. Minah. (1898) 15. — *Panax secundum* SCHULT. Syst. 6 (1820) 215, *nom. superfl. illeg.* —**

*Panax bandanense* ZIPP. ex SPAN. Linnaea 15 (1841) 208, *nom. inval. in synon.* — *Paratropia cumingiana* PRESL, Epim. (1851) 250. — *Nothopanax pinnatum* (LAMK) MIQ. Bonplandia 4 (1856) 139; MIQ. Fl. Ind. Bat. 1, 1 (1856) 766; MERR. Int. Rumph. (1917) 409; En. Born. (1921) 458; HEYNE, Nutt. Pl. (1927) 1209; OCHSE & BAKH. Veg. D.E.I. (1931) 67, f. 38; CORNER, Ways. Trees (1940) 156. — *Nothopanax cumingii* (PRESL) SEEM. Fl. Vit. (1865) 114. — *Aralia filicifolia* C. MOORE, Ill. Hort. 23 (1876) 72, t. 240. — *Arthrophyllum pinnatum* (LAMK) CLARKE, Fl. Br. Ind. 2 (1879) 734, *pro basionym.* — *Panax cumingiana* (PRESL) ROLFE, J. Linn. Soc. Bot. 21 (1884) 310; VIDAL, Phan. Cuming. (1885) 117. — ? *Aralia naumannii* E. MARCHAL, Bot. Jahrb. 7 (1886) 469. — *Panax crispatum* BULL., Cat. (1888) 9. — *Panax ornatum* BULL., l.c. — *P. cumingii* (PRESL) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45. — *P. rumphiana* HARMS, l.c. 45; in K. Sch. & Laut. Fl. Schutzgeb. (1900) 485; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 13; BACK. & BAKH. f. Fl. Java 2 (1965) 167. — *Nothopanax crispatum* (BULL) MERR. Philip. J. Sc. 7 (1912) Bot. 241. — *Nothopanax ornatum* (BULL) MERR. l.c. — *P. filicifolia* (C. MOORE) BAILEY, Rhodora 18 (1916) 153. — *P. sorongensis* GIBBS, Arfak (1917) 216. — *Anomopanax cumingianus* (PRESL) MERR. Philip. J. Sc. 17 (1920) 300; En. Philip. 3 (1923) 236.

Glabrous shrub or small tree, to c. 4 m, unbranched or with few branches bearing spirally arranged leaves towards their ends. *Leaves* imparipinnate, up to 100 cm; petiole to 20 cm, with a sheathing base c. 5–6 cm long; petiolules to 3 cm; leaflets ovate-oblong or elliptic, 10–30 by 2–13 cm, apex attenuated or acuminate, base rotund, truncate or broadly cuneate, often oblique, margin entire or minutely and distantly dentate (sometimes pinnatilobed or almost pinnatipartite); midrib and lateral veins evident. *Inflorescence* a large terminal panicle, or with flowering branches also in the axils of the upper leaves; primary axis up to 140 cm with secondary branches mostly in verticils at intervals along its length; secondary branches up to 120 cm, bearing umbellules in an irregularly branched system towards their extremities, peduncles of the umbellules with one or more pairs of small bracts; umbellules with c. 10–20 flowers; pedicels 4–8 mm. *Calyx* a minute rim with 4–5(–6) teeth. *Petals* 4–5(–6),  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long. *Stamens* 4–5(–6), 2 mm long. *Ovary* turbinate, c. 2 mm long, 2–5-celled; styles at first erect, later spreading. *Fruit* subglobose, fleshy, 3–5 mm  $\varnothing$  when dry.

*Distr.* Cultivated throughout the region, and also apparently growing as part of the indigenous vegetation.

*Ecol.* Rain-forest and secondary growth, usually at low altitude but ascending to 1700 m, native range not very clear.

*Uses.* A common ornamental shrub, especially



the cultivars with dissected foliage. Also for culinary use.

Vern. (from various sources). Celebes: *daun grisik*, *d. mangko*, *d. papéda pandang*, M, Manado; Philippines: *bani*, Luzon, Albay; Moluccas: *kèndèm*, Ternate, *gurabati*, M; *papua*, Jappen I.; New Britain: *awalagu*, Gazelle Pen.

OCHSE & BAKHUIZEN VAN DEN BRINK record that the vernacular names applied to *P. fruticosum* also include *P. cumingianum*.

Notes. A complex of forms requiring intensive biosystematic study. I adhere to the view that the Indo-Malayan material is specifically distinct from the Polynesian *Polyscias pinnata* J. R. & G. FORSTER; cf. HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45; PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 9, but some cultivated forms included here may have been derived from the Pacific rather than the Indo-Malayan species. Existing herbarium material, though voluminous, is inadequate to determine whether the complex includes species with more limited ranges.

As in 1. *P. fruticosa*, cultivated forms with dissected foliage occur.

See also under 4. *P. scutellaria* for a discussion of the relationship with that species.

I have not seen the type of *Aralia naumannii* MARCHAL which, from the description, I assume to be a synonym.

7. *Polyscias javanica* K. & V. Bijdr. 7 (1900) 13; KOORD. Atlas 4 (1916) f. 679 A–R; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 12; BACK. & BAKH. f. Fl. Java 2 (1965) 167; PHILIPSON, Blumea 24 (1978) 169.

## 2. Section Gelibia

(HUTCH.) PHILIPSON, Blumea 24 (1978) 169. — *Gelibia* HUTCH. Gen. Fl. Pl. 2 (1967) 57.

Tree with bipinnate leaves. Flowers arranged racemously; style arms free and divergent after anthesis.

Distr. In New South Wales, Queensland, and *Malesia* (New Guinea) 1 *sp.*

8. *Polyscias elegans* (C. MOORE & F.v.M.) HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45; J. Arn. Arb. 20 (1939) 323; PHILIPSON, Blumea 24 (1978) 169. — *Panax elegans* C. MOORE & F.v.M. Trans. Phil. Inst. Vict. 2 (1858) 68; BTH. Fl. Austr. 3 (1866) 383; C. MOORE, Handb. Fl. N.S.W. (1893) 215. — *Nothopanax elegans* (C. MOORE & F.v.M.) SEEM. Fl. Vit. (1866) 114; J. Bot. 4 (1866) 294. — *Tieghemopanax elegans* (C. MOORE & F.v.M.) VIGUIER, Bull. Soc. Bot. Fr. 52 (1905) 308. — *P. branderhorstii* HARMS, Nova Guinea 8 (1910) 274; Bot. Jahrb. 56 (1920) 42; J. Arn. Arb. 20 (1939) 323. — *Gelibia branderhorstii* (HARMS)

Glabrous shrub or sparsely branched small tree, bearing spirally arranged leaves towards the ends of the branches. *Leaves* imparipinnate, c. 70 cm long; petiole c. 17 cm, with a wide membranous sheathing base (c. 7 cm long); petiolules c. 1 cm; leaflets ovate to elliptic-oblong, up to 22 by 8 cm, membranous, apex attenuated, base rounded to broadly cuneate, often oblique, margin entire or minutely distantly dentate, slightly revolute, midrib and lateral veins prominent. *Inflorescence* a panicle; rachis 40 cm, with caducous bracts (reduced leaves or leaf-sheaths), bearing few secondary branches and terminating in a compound umbel; secondary branches with one or more verticils of tertiary branches; peduncles of the umbellules with one obscure bract or none; umbellule of c. 10–20 flowers, pedicels c. 5 mm. *Calyx* an undulate rim, indistinctly 5-dentate. Petals 5, 2<sup>1</sup>/<sub>2</sub>–3 mm long. Stamens 5, with very short filaments. Ovary turbinate, 1<sup>1</sup>/<sub>2</sub> mm high, 5-celled, styles at first erect, later recurved. Fruit a globose or obovoid fleshy drupe (prominently 5-ribbed when dry) c. 7 by 5 mm; persistent styles united below, strongly reflexed above.

Distr. *Malesia*: East Java, Lesser Sunda Is. (Lombok, Sumbawa, Sumba).

Ecol. In forest up to 1650 m.

Uses. The root is said to be made into a face powder in Sumbawa.

Vern. Lesser Sunda Is.: *pulosari*, Sumbawa, *amdari*, Sumba.

Note. The vegetative parts are rather similar to those of 6. *P. cumingiana*, but the smaller and simpler inflorescence is distinctive.

HUTCH. Gen. Fl. Pl. 2 (1967) 57. — *Gelibia elegans* (C. MOORE & F.v.M.) HUTCH. l.c. 58

Tree to 20 m high, with a spreading crown of thick branches bearing terminal clusters of large leaves, young parts with fawn to grey scurfy tomentum. *Leaves* bipinnate, becoming glabrous, up to 110 by 50 cm, or larger; petiole c. 13 cm, with a slightly clasping base; petiolules up to c. 1<sup>1</sup>/<sub>2</sub> cm; leaflets ovate or elliptic, c. 6 by 3 cm, chartaceous to somewhat leathery, margin entire and slightly revolute, apex with an obtuse apiculum, base cuneate, midrib prominent, lateral veins rather obscure. *Inflorescence* a large panicle,

tomentum persistent especially on the pedicels; primary axis stout, *c.* 30 cm, bearing secondary axes along its length and in a terminal subumbellate cluster, bracts caducous; secondary axes *c.* 20–30 cm, bearing tertiary axes (*c.* 10 cm) along their length; flowers borne racemously along the tertiary axes on pedicels 1–2 mm long. *Calyx* a minute rim. Petals 5, oblong, rather fleshy, spreading at anthesis and soon falling. Stamens 5, 2 mm long on short filaments, soon falling. Ovary scurfy, at first turbinate, globose at anthesis, *c.* 4 mm high, 2-celled, disk rising to the 2 styles; style arms at first short and pressed together, elongating and diverging after the anthers have fallen. *Fruit* leathery, globose, compressed, *c.* 5 by 5 mm and irregularly ribbed when dry.

Distr. New South Wales and Queensland; in

*Malesia*: New Guinea (West Irian, Southern Distr.; Papua, Western & Central Distr.).

Ecol. Gallery and second growth forest in (seasonal) monsoon regions, at low altitudes, up to 300 m.

Notes. The racemose flower arrangement has sometimes been considered sufficiently distinctive to justify the accommodation of this species in a separate genus.

The bark is described as grey or patched grey-brown; the wood as soft and pale; and the cut surfaces having a clear sticky exudate which has a pleasant fragrance. The inflorescence branches are purplish, the petals maroon, the anthers cream to yellow on reddish filaments, and the fruit purplish and smooth.

### 3. Section *Eupteron*

(MIQ.) PHILIPSON, *Blumea* 24 (1978) 170. — *Eupteron* MIQ. Pl. Jungh. 3 (1855) 420; Fl. Ind. Bat. 1, 1 (1856) 762.

Trees or shrubs with imparipinnate or bipinnate leaves. Flowers in umbellules or capitula; style arms divergent at least in fruit.

Distr. In *Malesia* 6 spp., but the section probably includes the majority of the genus in other parts of the Old World tropics.

Note. With the exception of 14. *P. philipsonii*, the Malesian spp. of sect. *Eupteron* have umbellules or capitula arranged racemously along the main inflorescence branches. The type species of the section (*P. nodosa*) has its flowers in capitula, but this is not considered a sufficient difference to require a separate section.

#### KEY TO THE SPECIES

- |   |                           |
|---|---------------------------|
| 1. Flowers in capitula . . . . .                            | 9. <i>P. nodosa</i>       |
| 1. Flowers in umbellules.                                   |                           |
| 2. Umbellules arranged racemously along the principal rays. |                           |
| 3. Leaf margins crenate.                                    |                           |
| 4. Leaflets oblong (Luzon) . . . . .                        | 10. <i>P. florosa</i>     |
| 4. Leaflets lanceolate (New Guinea) . . . . .               | 11. <i>P. ledermannii</i> |
| 3. Leaf margins entire (rarely with few minute dentations). |                           |
| 5. Leaflets ovate (Sabah, Palawan) . . . . .                | 12. <i>P. borneensis</i>  |
| 5. Leaflets elliptic (New Guinea) . . . . .                 | 13. <i>P. belensis</i>    |
| 2. Umbellules in a short corymbose compound umbel . . . . . | 14. <i>P. philipsonii</i> |

9. *Polyscias nodosa* (BL.) SEEM. J. Bot. 3 (1865) 181; F.-VILL. Nov. App. (1880) 102; VIDAL, Phan. Cuming. (1885) 117; Rev. Pl. Vasc. Filip. (1886) 145; BOERL. Handl. 1 (1890) 647; HARMS in E. & P. Nat. Pl. Fam. 3, 8 (1894) 44; KOORD. Minah. (1898) 491; K. & V. Bijdr. 7 (1900) 11; MERR. Philip. J. Sc. 1 (1906) Suppl. 110; KOORD. Exk. Fl. Java 2 (1912) 716; Atlas 4 (1916) f. 677 & 678; MERR. Int. Rumph. (1917) 408; Sp. Blanc. (1918) 294; En. Philip. 3 (1923) 233; HEYNE, Nutt. Pl. (1927) 1208; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 12;

BACK. & BAKH. f. Fl. Java 2 (1965) 167; PHILIPSON, *Blumea* 24 (1978) 170. — *Papaya silvestris* RUMPH. Herb. Amb. 1: 149, t. 53 f. 1. — *Aralia nodosa* BL. Bijdr. (1826) 872. — *Paratropia nodosa* (BL.) DC. Prod. 4 (1830) 265; PRESL, Epim. (1851) 250. — *Aralia umbraculifera* ROXB. [Hort. Beng. (1814) 22, *nomen*;] Fl. Ind. ed. Carey 2 (1832) 108. — *Aralia pendula* BLANCO, Fl. Filip. (1837) 223; ed. 2 (1845) 157; ed. 3, 1 (1877) 283. — *Hedera nodosa* (BL.) HASSK. Tijds. Nat. Gesch. Phys. 10 (1843) 131. — *Eupteron nodosa* (BL.) MIQ. Pl. Jungh. 3 (1855) 420; Fl. Ind. Bat. 1, 1 (1856) 762; Ann.



Mus. Bot. Lugd.-Bat. 1 (1864) 220; HUTCH. Gen. Fl. Pl. 2 (1967) 68. — ? *P. acuminata* VIDAL, Sinopsis Atlas (1883) 28, t. 55 f. A, *non* SEEM. 1865; F.-VILL. Nov. App. (1880) 102. — *P. floribunda* ELMER, Leaflet Philip. Bot. 10 (1939) 3819, *nom. inval. in synon.* — Fig. 28.

Tree to 25 m, unbranched or with few thick branches, bearing tufts of long leaves at their ends, young parts scurfy-tomentose. *Leaves* imparipinnate, multijugate, becoming glabrous or minutely villous on the nerves beneath, up to 2 m (or even 3 m); petiole c. 30 cm, to 2 cm  $\varnothing$ , with a short sheathing base; leaflets sessile, ovate-oblong commonly 15 by 4 cm, or larger, chartaceous, margin slightly crenate, apex  $\pm$  apiculate, base truncate. *Inflorescence* a large panicle (sometimes with additional flowering branches in the axils of the upper leaves), tomentum  $\pm$  persistent; primary axis stout, c. 1½ m, bearing secondary axes along its length, bracts triangular, c. 5 mm long; secondary axes c. 20–40 cm; capitula borne racemously along the secondary branches on peduncles c. 6–15 mm long. *Flowers* c. 8–12 in a capitulum. *Calyx* a minute rim. Petals 5, triangular, 2 mm long. Stamens 5, anthers broadly ovate on short filaments. Ovary turbinate, c. 2½ mm high, 5-celled; disk flat, rising to the 5 central erect styles. *Fruit* subglobose (5-ribbed when dry), styles spreading and reflexed.

Distr. Solomon Is. (Bougainville); in *Malesia*: Sunda Straits (Krakatau), Java, Lesser Sunda Is. (Lombok), Celebes, throughout the Philippines and Moluccas (Talaud, Ternate, Sulu Is., Ceram, Ambon, Banda, Tenimber, Aru Is.), New Guinea (eastwards to Milne Bay Distr.).

Recorded doubtfully, on sterile material, from the Andaman Is. by KURZ (Veg. Andam. Is. 1870, 39) but unlikely as it is absent from Sumatra, Malaya, and Borneo.

Ecol. Open thickets and rain-forest, mostly at low altitudes and on small islands, but recorded to 1000 m.

Uses. Used medicinally against purpuric fever and to delay pregnancy (Mindanao). The leaves are used to stupify fish and the wood makes durable fence posts and handles for rice-knives.

Vern. (from various sources). Java: *ki langit*, *S*, *dëleg*, *djaranan*, *mangle*, *putëngan*, *J*, *pënan-pënan*, *Md*, *kaju djaran*, *k. lanang*, *rangit*, *tjaliru*, *tua kalap*; Philippines: *bias-bias*, *bingliu*, *Tag.*, *Bis.*, *bungloi*, *Bis.*, *bon liu*, *bungliu*, *goyung-góyung*, *Tag.*, *bungdiu*, *Ig.*, *hagdan-anak*, *C.Bis.*, *mano-mano*, *Yak.*, *malapapaya*, *Tag.*, *Bis.*, *Pang.*, *tukod-lángit*, *Tag.*, *Pamp.*; Celebes: *kambowa*, *lalusuhan*, *pasusinggala*, (*pohon*) *mamalapa*, *tamala*, *tulu*, *tundu*; Sulu Is.: *lua*; Moluccas: *kobo-kobo*, *Morotai*, *batatopus*, *Ceram*, *papaya utan*, *pata tulan*, *p. tulong*, *Ambon*, *matanglolan*, *Tenimber*; West New Guinea: *amorigh*, *lulako*, *sonomdoro*, *totja*.

Note. A widespread, common and noticeable

species. The flowers are described as yellow and as having a fragrant scent. The wood is soft and white.

#### 10. *Polyscias florosa* PHILIPSON, Blumea 24 (1978) 170.

Small tree, up to 10 m, with thick branches bearing terminal clusters of large leaves, glabrescent. *Leaves* imparipinnate, multijugate, up to 2 m; petiole c. 25 by 1½ cm, with a short sheathing base; leaflets sessile, oblong, c. 22 by 8 cm, chartaceous, margin crenate, apex slightly to long acuminate, base truncate or subcordate. *Inflorescence* a large glabrescent panicle; principal rays over 1 m, up to 3 cm  $\varnothing$ , each bearing secondary branches (20–40 cm) along its length; bracts broadly ovate, 1 cm long, caducous; umbellules borne racemously along the secondary branches on peduncles 1–2 cm long (in fruit to c. 4 cm). *Flowers* c. 6–12 in an umbellule, pedicels 3–5 mm with 2 minute bracts near the middle. *Calyx* an undulate rim. Petals 5, oblong, 3 mm long. Stamens 5. Ovary turbinate, c. 2 mm long, 5-celled, disk flat, rising to the 5 central erect styles. *Fruit* subglobose (5-ribbed when dry), 8 by 6 mm, styles spreading and reflexed.

Distr. *Malesia*: Philippines (Luzon; Mt Bulusan, Sorsogon Prov. and Mt Malinao, Albay Prov.).

Ecol. Rarely collected in montane forest, c. 560 m.

Note. The leaves are very similar to those of *P. nodosa*, with which this species has often been confused. However the pedicelled flowers are quite distinctive.

#### 11. *Polyscias ledermannii* HARMS, Bot. Jahrb. 56 (1921) 409; PHILIPSON, Blumea 24 (1978) 170. — *Panax murrayi* (*non* F.v.M.) F.v.M. Descr. Pap. Pl. 7 (1886) 29; BOERL. Handl. 1 (1890) 647. — *P. forbesii* BAKER f. J. Bot. 56 (1923) Suppl. 22. — *P. clemensiana* HARMS, Bot. Jahrb. 69 (1938) 283.

Glabrous tree, to 28 m, with few thick branches bearing terminal clusters of large leaves. *Leaves* imparipinnate, up to 1¼ m; petiole to c. 16 cm, base slightly dilated; petiolules c. 2–4 mm; leaflets lanceolate or oblong-lanceolate, c. 10–20 by 2–4 cm, papyraceous, margin crenulate, apex acuminate, base truncate or rounded, often oblique, midrib prominent, lateral veins numerous, faint. *Inflorescence* a panicle; primary axis stout, c. 15 cm, bearing crowded secondary axes along its length and in a subumbellate cluster at its apex, bracts triangular, c. 3 mm long, caducous; secondary axes 20–30(–40) cm; umbellules borne racemously along the secondary axes (often in subverticils) on peduncles 2–5 cm long, usually bearing 2 minute bracts. *Flowers* c. 8–12 in an umbellule, pedicels c. 5 mm. *Calyx* a minute rim. Petals 2½ mm long. Stamens 5. Ovary turbinate, 2 mm high, 3–4-celled, disk rising to the central styles. *Fruit*

globose, 4–5 mm high (when dry), 3–4-ribbed, styles 3–4, divergent, persistent.

Distr. *Malesia*: New Guinea (Vogelkop to Milne Bay).

Ecol. In rain-forest, gallery forest and secondary growths, usually above 1500 m (to 3000 m), but occasionally as low as 500 m.

Vern. *Agugwa*, Hagen, *gapin*, Morobe Distr., *gowi*, Efogi lang., *panda panda*, Mendi lang., *puri*, Kepilan.

Notes. A common small tree. CARR estimated the height of one specimen as 28 m, but most are considerably smaller. The flowers are described as green. The wood is soft and pale. The plant has a scent resembling celery.

The species closely resembles *P. murrayi* (F.v.M.) HARMS from Queensland.

**12. *Polyscias borneensis*** PHILIPSON, J. Bot. 78 (1940) 118; *Blumea* 24 (1978) 170.

Glabrous shrub or small tree with few thick branches bearing terminal clusters of leaves. *Leaves* imparipinnate, c. 50 cm; petiole c. 15 cm, base slightly dilated; petiolules c. 1 cm; leaflets ovate, up to 10 by 4 cm, coriaceous, margin entire or slightly undulate, apex attenuate, base rounded or broadly cuneate, often asymmetrical, midrib prominent, lateral veins rather obscure. *Inflorescence* a large panicle; primary axis stout, up to c. 40 cm, bearing secondary axes along its length and in a subumbellate cluster at its apex, bracts triangular c. 5 mm long; secondary axes c. 35 cm; umbellules borne racemously along the upper part of the secondary branches on peduncles 2–5 cm long. *Flowers* about 10 in an umbellule, pedicels c. 10 mm long. *Calyx* a minute undulate rim. Petals oblong 3 mm long. Stamens 5, oblong c. 2½ mm long, filaments 2 mm. Ovary turbinate, 2 mm high, 5-celled, disk rising to the 5 central erect styles. Fruit unknown.

Distr. *Malesia*: N. Borneo (Mt Kinabalu), Philippines (Palawan, Mt Mantalingahan).

Ecol. Montane forest, c. 1500 m.

Note. Specimens collected on Palawan by EDAÑO were distributed with the specific epithet '*palawanensis*', but this name was never published.

**13. *Polyscias belensis*** PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 13; *Blumea* 24 (1978) 170.

Glabrous tree, to 14 m. Branches bearing terminal clusters of large leaves. *Leaves* imparipinnate, up to 80 cm long; petiole c. 12–16 cm, base slightly dilated; leaflets subsessile or with a petiolule to 1 cm; leaflets elliptic to narrowly elliptic, c. 12 by 3½–6 cm, subcoriaceous, margin entire or sparsely denticulate, slightly revolute, narrowed to an obtuse apex, base cuneate, midrib prominent, lateral veins c. 12. *Inflorescence* a panicle; primary axis stout, c. 18–22 cm, bearing many secondary branches along its length and in a subumbellate cluster at its apex, bracts caducous; secondary

axes c. 22–35 cm, bearing umbellules racemously along their length, bracts triangular c. 3 mm long; peduncles c. 1½–3 cm. *Flowers* c. 10 per umbellule, pedicels 5–6 mm. *Calyx* a minute rim. Petals 4, oblong. Stamens 4, anthers oblong, 2 mm long, filaments very short. Ovary turbinate, 1½–2 mm high (in anthesis), 4–5-celled, disk flat with 4–5 free styles, at first erect, later divergent. Fruit unknown.

Distr. *Malesia*: New Guinea (West Irian, Bele R. near Lake Habbema; Papua, Morobe Distr., Mt Kaindi and Aseki Patrol area).

Ecol. Infrequent tree in montane forest and regrowth, 1450–2650 m.

Note. The inflorescence is similar to that of 11. *P. ledermannii*, but the shape of the leaflets is distinctive. In the type (from West Irian) the leaf margins are entire, but in the three gatherings from Morobe there are some dentations, and it is possible these are not conspecific. The corolla is maroon (Morobe). The plant has an odour like celery.

**14. *Polyscias philipsonii*** BERNARDI, Ber. Schweiz. Bot. Ges. 74 (1966) 364; PHILIPSON, *Blumea* 24 (1978) 170. — *P. fraxinifolia* PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 13, *non* HARMS, 1894.

A sympodial, unbranched, glabrous shrub or epiphyte to 2 m high, with leaves spirally arranged towards the apex, new shoots arising below the inflorescence. *Leaves* imparipinnate, or occasionally 3 leaflets inserted together, or the leaves bipinnate, up to 35 cm long; petiole to 10 cm, with a very short sheathing base; petiolules to 7 mm, leaflets variable in size and shape, broadly or narrowly elliptic, up to 9 by 4½ cm, but usually smaller, narrowed to the apex or apiculate, base cuneate or rounded, margin minutely setose-crenulate, midrib prominent, lateral veins few, arched-ascending. *Inflorescence* a corymb; peduncle short, 1–2 cm, sometimes bearing a reduced leaf or cataphyll distally; primary rays c. 5, subequal, c. 3–4½ cm, bearing terminal compound umbels (occasionally with a lateral umbel); ultimate umbellules with 6–12 flowers on pedicels c. 4 mm long. *Calyx* a minute rim with indistinct teeth. Petals 5, triangular, 2 mm long. Stamens 5, anthers oblong, 1 mm long. Ovary turbinate, c. 2 mm high, 5-celled, the fleshy disk rising to the 5 central erect styles. *Fruit* fleshy, globose, 5-ribbed when dry, c. 4 by 6 mm, styles persistent, recurved.

Distr. *Malesia*: West New Guinea (Idenburg R.).

Ecol. In mossy forest at 1800 m, and on an exposed slope at 2150 m.

Notes. The short corymbose inflorescence is similar to that in *sect. Palmervandenbroekia*, but the free recurved style arms exclude it from that section.

The shrub is variable in aspect, and may grow as an epiphyte or as an undershrub. The panicle branches are described as purple and the flowers as green.



4. Section *Kissodendron*

(SEEM.) PHILIPSON, *Blumea* 24 (1978) 170. — *Kissodendron* SEEM. *J. Bot.* 3 (1865) 201.

Trees or shrubs with pinnate or bipinnate leaves. Umbellules arranged in diffuse panicles. Style arms fused, forming a beak-like projection on the fruit.

Distr. In *Malesia* (Moluccas and New Guinea) 5 spp., three of which extend to Queensland.

## KEY TO THE SPECIES

- |  |                           |
|--|---------------------------|
| 1. Leaves bipinnate. . . . .                                   | 15. <i>P. bipinnata</i>   |
| 1. Leaves simply imparipinnate.                                |                           |
| 2. Leaflets in 3–4(–5) pairs . . . . .                         | 16. <i>P. zippeliana</i>  |
| 2. Leaflets in more than 5 pairs.                              |                           |
| 3. Fruits rotund, c. 8 mm broad . . . . .                      | 17. <i>P. royenii</i>     |
| 3. Fruits ovoid, c. 4–5 mm broad.                              |                           |
| 4. Base of leaflets cuneate . . . . .                          | 18. <i>P. schultzei</i>   |
| 4. Base of leaflets truncate, subcordate, or rounded . . . . . | 19. <i>P. australiana</i> |

**15. *Polyscias bipinnata*** (GIBBS) PHILIPSON, *Blumea* 24 (1978) 170. — *Kissodendron bipinnatum* GIBBS, *Arfak* (1917) 161; HARMS, *Bot. Jahrb.* 56 (1921) 413.

A small tree; branches with spirally arranged leaves towards their ends; young parts brown furfuraceous. *Leaves* bipinnate, 70 by 68 cm; petiole 26 cm, with a short sheathing base; rachis with a pair of leaflets at each articulation; petiolules to 1 $\frac{1}{4}$  cm; leaflets narrowly oblong or ovate, c. 6–12 by 2 $\frac{1}{2}$ –4(–5) cm, apex attenuated, base broadly cuneate or rounded, margin entire, irregularly undulate slightly revolute, midrib prominent.

*Inflorescence* a diffuse panicle (sometimes also with flowering branches in the axils of the upper leaves); peduncle c. 6 cm, terminating in few (3) primary rays; primary rays 40–50 cm, bearing verticils of pairs of secondary branches along their length and ending in a compound umbel; umbellules of c. 10–15 flowers on pedicels c. 10 mm long. *Calyx* an undulate rim. Petals 5, 2 $\frac{1}{2}$  mm long. Stamens 5, filaments 1 mm, anthers 1 $\frac{1}{4}$  mm long. Ovary turbinate 2–3-celled, disk with a central stylopodium 1 mm long. Fruit ovoid, fleshy, 5 by 3 mm (when dry) crowned by the calyx rim and the beak-like stylopodium, stigmas minutely capitate.

Distr. *Malesia*: W. New Guinea (Vogelkop: Angi Lakes).

Ecol. Montane forest, at c. 2000 m.

Vern. *Louklouwko*.

Note. The individual leaflets are similar to those of 18. *P. schultzei*, but their bipinnate arrangement is distinctive. The flowers are white.

**16. *Polyscias zippeliana*** (MIQ.) VALETON, *Bull. Dép. Agr. Ind. Néerl.* 10 (1907) 42; PHILIPSON, *Blumea* 24 (1978) 170. — *Panax zippelianum* MIQ. *Ann. Mus. Bot. Lugd.-Bat.* 1 (1863) 15; BOERL.

Handl. 1 (1890) 645; HARMS in E. & P. *Nat. Pfl. Fam.* 3, 8 (1894) 46. — *Nothopanax zippelianum* (MIQ.) SEEM. *Fl. Vit.* (1866) 115. — *Kissodendron australianum* [non (F.v.M.) SEEM.] BOERL. *Handl.* 1 (1890) 650. — *P. caroli* HARMS, *Bot. Jahrb.* 56 (1920) 411.

Shrub, 1 $\frac{1}{2}$ –(5) m, with few branches, bearing leaves spirally arranged near their ends, glabrous except a slight rufous tomentum on young parts. *Leaves* imparipinnate, with 3–4 pairs of leaflets, up to c. 60 cm; petiole to 17 cm, with a very short sheathing base; petiolules  $\frac{1}{2}$ –1 $\frac{1}{2}$  cm; leaflets oblong, ovate or elliptic, 6–13 by 3 $\frac{1}{2}$ –6 cm, papyraceous, apex attenuate or apiculate, base cuneate, often oblique, margin entire, slightly revolute, midrib and few lateral veins evident. *Inflorescence* a panicle, often appearing lateral by rapid growth of a bud at its base; branches rather fine and wiry, rachis often angled at the nodes, up to c. 60 cm; secondary branches borne singly at wide intervals and in a few rayed terminal umbels, c. 20 cm long, bearing umbellules on side branches and terminally; umbellules with c. 10–15 flowers on pedicels  $\frac{1}{2}$ –1 cm long. *Calyx* a minute rim. Petals 5, broadly oblong, 2 mm long. Stamens 5, anthers oblong, 1 mm long, filaments 1 mm. Ovary turbinate, 2 mm high, 2-celled, the fleshy disk rising to the central fused styler column. *Fruit* ovoid, crowned by the prominent stylopodium with a capitate stigma, c. 7 by 4 mm when dry.

Distr. *E. Malesia*: SE. Moluccas (Aru Is.) and New Guinea (S. Irian and southern part of Western Distr. of Papua; also in the Sepik Distr.).

Ecol. In the Aru Is. and S. New Guinea in obviously seasonal savannah country associated with *Acacia* and *Melaleuca* at low altitudes, in the Sepik Distr. in the mountains at c. 1000 m.

Vern. *Mirmur, uwah, perdi-perdi*, W. Irian.



Fig. 30. *Polyscias schultzei* HARMS. a. Habit,  $\times \frac{2}{5}$ , b. flower and ditto in LS,  $\times 10$ , c. petal, d. stamens, e. fruit and ditto in CS,  $\times 5$  (a-d HOOGLAND & PULLEN 5841, e KALKMAN 4200). Drawn by HELENE MULDER.



Notes. The identity of *P. zippeliana* has been discussed by BOERLAGE, VALETON, and HARMS, *ll.cc.* The short leaf-sheath and the connivent styles place it within *sect. Kissodendron*.

A comparison of the type specimen with the species usually known as *P. caroli* HARMS shows them to be conspecific. The type of *P. caroli* is no longer available but specimens collected by BRASS can be considered authentic as they were identified by HARMS. It should be noted, however, that the type of *P. caroli* is from the Sepik Distr. (probably in rain-forest) at 1000 m, while all other specimens are from the south of the island and from seasonal savannahs at much lower altitudes.

The single gathering from the Aru Is. approaches 19. *P. australiana* having larger leaves with more pairs of leaflets than other gatherings of *P. zippeliana*.

**17. *Polyscias royenii* PHILIPSON, Blumea 24 (1978) 170.**

Small tree up to 5(–15) m, monocaulous sympodial, persistently rufous-furfuraceous, with leaves spaced along the upper part of the stem. *Leaves* imparipinnate, with *c.* 9 pairs of leaflets, up to 100 cm long or more; petiole to 30 cm, with a short sheathing base; petiolules of mid-leaflets *c.* 8–20 mm; leaflets normally oblong-ovate, broadest near the base, up to 24 by 11 cm, coriaceous, apex attenuated or apiculate, base truncate to subcordate; often oblique, margin entire, irregularly undulate, slightly revolute; midrib prominent, reticulations depressed above (rugose) raised and furfuraceous below. *Inflorescence* a panicle, flowering branches also often present in the axils of the uppermost leaves; rachis up to 60 cm with verticils of secondary branches subtended by caducous unifoliate bracts and a terminal compound umbel; lower secondary branches up to 50 cm, with verticillate tertiary branches and terminal compound umbels; umbellules with 10–20 flowers on furfuraceous pedicels *c.* 8 mm long. *Calyx* a furfuraceous rim, with 5 small teeth. Petals 5, strap-shaped, *c.* 3 mm long, soon falling. Stamens 5. Ovary subcylindric, furfuraceous, *c.* 3 mm long, 2(–3)-celled, the fleshy disk forming a projecting conical stylopodium 2 mm long; stigmas 2, appressed at anthesis. *Fruit* rotund, compressed, with prominent ribs when dry 7–9 by 8–10 mm, crowned by the prominent persistent calyx and a short stout beak-like stylopodium; stigmas short, divergent.

Distr. *Malesia*: New Guinea (Cyclops Mts to the E. Highlands Distr.).

Ecol. Terrestrial or epiphytic in primary or secondary montane forest, 1200–2400 m.

Vern. Irian: *ato*, Kapauku lang.; Papua New Guinea: *habia*, S. Highlands, *magabin*, W. Sepik, *momin*, Mendi lang.

Note. A species readily characterized by the sympodial monocaual habit with thick leathery

leaflets, a large rigid furfuraceous inflorescence, and large, compressed, black fruits with a glaucous bloom.

**18. *Polyscias schultzei* HARMS, Bot. Jahrb. 56 (1921) 410; PHILIPSON, Blumea 24 (1978) 171. — *P. gjellerupii* HARMS, Bot. Jahrb. 56 (1921) 410. — Fig. 30.**

Shrub or small tree, often unbranched, 4–20 (–26) m high, young parts densely brown furfuraceous, branches with spirally arranged leaves towards their ends. *Leaves* imparipinnate, to 80 cm long, with *c.* 8–11 pairs of leaflets; petiole up to 35 cm, with a short sheathing base; petiolules *c.* 8 mm; leaflets ovate-lanceolate, oblong or elliptic, up to 14(–17) by 4–5 cm, apex attenuated or acuminate, base broadly cuneate, oblique, margin entire, midrib prominent. *Inflorescence* a diffuse, repeatedly compound umbel, with reduced leaves  $\pm$  persistent at the nodes; peduncle usually rather short (*c.* 5 cm) ending in a group of several primary rays (and sometimes with one or more lateral rays); primary rays 50–60 cm, with verticils and a terminal umbel of secondary rays which in turn are branched; umbellules with *c.* 5–10 flowers on fine pedicels *c.* 5–8 mm long (elongating in fruit to 12–15 mm). *Calyx* a minute rim with 4–5 small teeth, usually glabrous but occasionally furfuraceous. Petals 4–5, *c.* 3 mm long. Stamens 4–5, 2 mm long. Ovary  $\pm$  cylindric, glabrous or occasionally furfuraceous, *c.* 2 mm long, 2-celled, the fleshy disk forming a blunt stylopodium. *Fruit* ovoid, fleshy, *c.* 5 mm long, crowned by the inconspicuous calyx and the projecting beak-like stylopodium (*c.* 2 mm long); stigmas slightly divergent or capitate.

Distr. Queensland; in *Malesia*: Moluccas (Morotai) and New Guinea (throughout most of the island, from the Vogelkop Peninsula and Japen I. to the Central and Morobe Distr.).

Ecol. Usually in lower and mid-montane rain-forest (with *Castanopsis*, *Nothofagus*, *Lithocarpus*), also in regrowth, usually above 1200 m, ascending to 2400 m, but also descending to near sea-level.

Vern. New Guinea: *atok*, Wissel Lakes, *funim*, Telefomin, *houklouwko*, Angi Lakes, *paul*, Wabag, *agugwa*, Hagen.

Notes. A widespread and frequently collected species recognized by the multijugate leaves with rather small, thin, attenuate leaflets with cuneate base. The flowers are white to yellowish and the fruits black. The grey bark exudes a small amount of gummy sap; the wood is white.

HARMS recognized that *P. gjellerupii* was very similar and the abundant material now available indicates the variability of this common species.

**19. *Polyscias australiana* (F.v.M.) PHILIPSON, Blumea 24 (1978) 171. — *Hedera australiana* F.v.M. Fragm. 4 (1864) 120; BTH. Fl. Austr. 3 (1866) 384. — *Kissodendron australianum* (F.v.M.)**

SEEM. J. Bot. 3 (1865) 201; *ibid.* 6 (1868) 129. — *Irvingia australiana* (F.v.M.) F.v.M. Fragm. 5 (1865) 18.

*var. disperma* (F.v.M.) PHILIPSON, *Blumea* 24 (1978) 171. — *Kissodendron australianum* (F.v.M.) SEEM. *var. disperma* F.v.M. Descr. Not. Pap. Pl. 5 (1877) 88; HARMS, Bot. Jahrb. 56 (1921) 412.

Small tree, often unbranched, branches with leaves arranged spirally towards their ends, young parts brown furfuraceous. *Leaves* imparipinnate, multijugate, to 1 m long; petiole *c.* 25 cm, with a short sheathing base; petiolules to 1½ cm; leaflets broadly ovate or oblong, broadest near the base, up to 14 by 6 cm, ± coriaceous, apex attenuated to an obtuse apex, or with an obtuse apiculum, base rounded, truncate, or subcordate, oblique, margin entire, slightly revolute, midrib and lateral veins prominent. *Inflorescence* a diffuse panicle (sometimes also with flowering branches in the axis

of the upper leaves); peduncle short, terminating in several primary rays, reduced leaves subtending the principal branches; primary rays *c.* 50 cm, bearing verticils of secondary branches along their length and ending in a compound umbel; umbellules of *c.* 10–15 flowers on pedicels *c.* 8–10 mm long. *Calyx* an undulate rim. Petals 5, *c.* 1½ mm long. Stamens 5, *c.* 1 mm long. Ovary turbinate, 2-celled, a fleshy disk rising to a low conical stylopodium. *Fruit* ovoid, fleshy, 6 by 4 mm (when dry), crowned by the persistent calyx and beak-like stylopodium (2 mm long).

Distr. *Malesia*: New Guinea (Vogelkop Peninsula and Southern Distr. in Papua).

Ecol. Primary rain-forest at low altitudes and also in lower montane forest at 1750 m.

Note. Distinguished from 18. *P. schultzei* by the leathery leaflets with a truncate base, and from 17. *P. royerii* by the smaller fruits.

### 5. Section *Palmervandenbroekia*

(GIBBS) PHILIPSON, *Blumea* 24 (1978) 171. — *Palmervandenbroekia* GIBBS, Arfak (1917) 162.

Trees or shrubs with imparipinnate leaves. Umbellules arranged in short corymbose compound umbels. Style arms fused, forming a beak-like projection on the fruit.

Distr. *Malesia*: New Guinea (Vogelkop Peninsula and Cyclops Mts in W. Irian, Western Distr. in Papua).

#### KEY TO THE SPECIES

1. Pedicels tomentose (at anthesis).
  2. Inflorescence a compact regular compound umbel with rigid rufous branches (Vogelkop and Cyclops Mts) . . . . . 20. *P. sleumeri*
  2. Inflorescence more open, less regularly branched, with branches becoming ± glabrous (Mt Bosavi, Papua) . . . . . 21. *P. jacobsii*
1. Pedicels glabrous (at anthesis).
  3. Flower buds lanceolate, stylopodium at anthesis *c.* 2 mm long (Vogelkop, Arfak Mts) . . . . . 22. *P. palmervandenbroekii*
  3. Flower buds ovoid, stylopodium at anthesis *c.* 1 mm long (Vogelkop, Nettoti Range and Aifat R.) . . . . . 23. *P. vogelkopensis*

20. *Polyscias sleumeri* PHILIPSON, *Blumea* 24 (1978) 171.

Monocaulous sympodial shrub, 1–1½ m, with leaves spaced along the upper part of the stem; young parts red-furfuraceous. *Leaves* imparipinnate, with 3–4 pairs of leaflets (leaflets occasionally in threes), *c.* 35 cm long; petiole to 9 cm, with a very short sheathing base; petiolules 8–15 mm; leaflets oblong, ovate or elliptic, up to 16 by 6 cm, chartaceous, apex attenuate or apiculate, base rounded or cuneate, margin entire, irregularly undulate, slightly revolute, midrib prominent. *Inflorescence* a compound umbel, red-furfuraceous

(stem growth renewed by a bud between the inflorescence and the uppermost leaf); peduncle 3–6 cm, bearing scars of caducous reduced leaves, occasionally with a lateral umbellule, and ending in an umbel of *c.* 7 primary rays; primary rays 1–2½ cm, sometimes with a minute bract near the middle; umbellule with 10–20 flowers on pedicels 2–3 mm long, densely furfuraceous. *Calyx* a rim with 5 broad teeth. Petals 5, broadly oblong, 3–4 mm long. Stamens 5, anthers 1 mm long, filaments 2 mm. Ovary turbinate, 2 mm high, 2-celled, the fleshy disk forming a projecting conical stylopodium; stigmas 2 appressed at anthesis.



*Fruit* rotund to ovoid compressed 5–6 by 5 mm crowned by the prominent persistent calyx and the beak-like stylopodium (2–2½ mm long); stigmas not prominent.

*Distr. Malesia:* New Guinea (Vogelkop Peninsula and Cyclops Mts).

*Ecol.* Undergrowth in primary forest, 450–1000 m.

*Note.* The flowers are creamy white, the fruit dark red.

**21. *Polyscias jacobsonii* PHILIPSON, Blumea 24 (1978) 171.**

A monocaulous sympodial shrub to 3 m high, with leaves spaced along the upper part of the stem, young parts furfuraceous. *Leaves* imparipinnate, 4–5 pairs of leaflets (leaves of juveniles smaller with fewer leaflets), c. 45 cm long; petiole to 12 cm, with a short sheathing base; petiolules 1–1½ cm; leaflets oblong or elliptic, c. 12 by 4 cm, chartaceous, apex attenuate or caudate, base truncate or cuneate, margin entire, irregularly undulate, slightly revolute, midrib prominent. *Inflorescence* a compound umbel (stem growth renewed by a bud between the inflorescence and the uppermost leaf); peduncle 1–4 cm (sometimes bearing a unifoliate leaf about the middle with an axillary flowering branch), ending in an umbel of 2–4 primary rays; primary rays sometimes subtended by 1–2 unifoliate leaves, c. 4 cm long, ending in 2–3 tertiary rays which may branch again before ending in umbellules; umbellules with 6–10 flowers on furfuraceous pedicels c. 8 mm long. *Flower buds* with an apical umbo. *Calyx* a rim with 5 acute teeth. Petals 5, attenuated. Stamens 3 mm long, anthers 1½ mm long. Ovary subcylindric, furfuraceous, 4 mm high, 2-celled, disk forming a projecting conical stylopodium (1½ mm long at anthesis), stigmas 2. *Fruit* rotund, compressed, 8 by 9 mm, crowned by the small calyx and the persistent stylopodium (2 mm long) with subcapitate stigmas.

*Distr. Malesia:* New Guinea (Papua: Mt Bosavi). Only known from the type.

*Ecol.* On old well-drained volcanic soil in primary mixed forest, mostly on ridges and upper slopes, 1600–2100 m.

*Note.* An aromatic, single-stemmed shrub. The flowers are white and the fruit dark purple.

**22. *Polyscias palmervandenbroekii* BERNARDI, Candollea 26 (1971) 16; PHILIPSON, Blumea 24 (1978) 171. — *Palmervandenbroekia papuana* GIBBS, Arfak (1917) 162, f. 15, non *P. papuana* SEEM. 1865.**

Glabrous shrub, c. 1½ m, sparsely branched, with leaves spaced along the upper parts of the stems. *Leaves* imparipinnate, with 3–5 pairs of leaflets, up to 13 cm long; petiole to 4 cm, slightly channelled above, with a very small sheathing

base; petiolules 0–5 mm; leaflets lanceolate, obovate to elliptic, 1¼–4 by ¾–2 cm, coriaceous or chartaceous, apex attenuated (sometimes emarginate) to apiculate, base cuneate, margin entire, revolute, midrib prominent, lateral veins obscure. *Inflorescence* a simple or compound umbel; peduncle slender, c. 2 cm; primary rays (when present) few, c. 1 cm; umbellules of c. 10 flowers on glabrous pedicels 3–6 mm long. *Flower buds* lanceolate, acute, 3–6 mm. *Calyx* a rim with 5 broad teeth. Petals 5, attenuate, 5–8 mm long. Stamens 5, filaments c. 3 mm, anthers c. 1 mm. Ovary turbinate, striate, 2 mm high, 2-celled, disk projecting as a conical stylopodium (2 mm long). *Fruit* ovoid, compressed, 6 by 5 mm, crowned by the persistent calyx and the beak-like stylopodium; stigmas 2, small, divergent.

*Distr. Malesia:* New Guinea (Vogelkop: Arfak Mts).

*Ecol.* In summit heath vegetation (*Tristania-Dacrydium* scrub) and *Nothofagus* forest, 1900–2400 m.

*Note.* Collections made since the original description show that this interesting plant is quite variable as regards leaf-shape, texture and amount of rolling of the margin, and also in the size of its flowers. The calyx is purplish brown, the petals reddish purple outside and white within. The ripe fruit is purplish black. The thin papery bark is light grey.

**23. *Polyscias vogelkopensis* PHILIPSON, Blumea 24 (1978) 171.**

An often monocaulous sympodial shrublet usually under 1 m high, with leaves spaced along the upper parts of the stem; young parts slightly furfuraceous, but soon becoming glabrous. *Leaves* imparipinnate, with 3–4 pairs of leaflets (leaflets occasionally in threes) variable in size; petiole 2–7 cm, slightly channelled above with a short inconspicuous sheathing base; petiolules 2–8 mm; leaflets elliptic or ovate, 3–12 by 1¼–4 cm, chartaceous, apex attenuated or apiculate, base broadly to narrowly cuneate, margin entire, irregularly undulate (occasionally with isolated dentations) slightly revolute, midrib prominent. *Inflorescence* a small compound umbel; peduncle up to 8 cm, occasionally with a lateral or basal umbellule, ending in c. 2–3 primary rays (sometimes subtended by a reduced leaf); primary rays 1–2 cm; umbellules with c. 10–15 flowers on glabrous pedicels c. 3–6 mm long. *Flower buds* ovoid, obtuse. *Calyx* a rim with 4–5 broad undulations. Petals 4–5, broadly oblong, 4 mm long. Stamens 4–5, anthers 1 mm, filaments 3 mm. Ovary turbinate, 2 mm high, 2-celled, the fleshy disk rising to a conical stylopodium (1 mm long); stigmas 2, appressed at anthesis. *Fruit* ovoid, compressed, 5 by 4 mm, crowned by the persistent calyx and the prominent beak-like stylopodium; stigmas inconspicuous.

Distr. *Malesia*: New Guinea (Vogelkop and Wandammen Peninsula, Nettoti Range and Aifat R.).

Ecol. Primary submontane forest (*Nothofagus*, *Castanopsis*, and conifers), heath vegetation, or in open places, 1200–2000 m.

Note. A delicate subshrub, often unbranched. The material from Aifat R. has larger leaves than that from the Nettoti Range. The flowers are cream or light yellow, and the fruits orange with black stylopodium.

#### Insufficiently known

*Polyscias disperma* BLANCO, Fl. Filip. (1837) 226; MERR. Sp. Blanc. (1918) 384; En. Philip. 3 (1923) 233. — Philippines.

MERRILL (1923, *l.c.*) stated that this name was excluded by BLANCO from his 2nd edition, and that it is unrecognizable from the very short and imperfect description. Possibly a *Rubiacea*.

*Polyscias roemeriana* HARMS, Bot. Jahrb. 56 (1921) 411. — New Guinea.

I have seen no authentic specimens of this species. Evidently it is related to *P. palmervandenbroekii* by reason of its connivent styles, its short inflorescence, and its small leaflets. However, bipinnate leaves are not known in that species.

#### Excluded

*Polyscias joskei* L. S. GIBBS, J. Linn. Soc. Bot. 39 (1909) 149. — This species was by error ascribed by Index Kewensis to the Philippines; it is from Fiji.

## 11. MACROPANAX

MIQ. Fl. Ind. Bat. 1, 1 (1856) 764; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 13; BTH. in B. & H. Gen. Pl. 1 (1865) 945; BOERL. Handl. 1 (1890) 643; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 47; HUTCH. Gen. Fl. Pl. 2 (1967) 80. — *Hederopsis* CLARKE, Fl. Br. Ind. 2 (1879) 739; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 56; KING, J. As. Soc. Beng. 67, ii (1898) 62; HUTCH. Gen. Fl. Pl. 2 (1967) 78; STONE, Gard. Bull. Sing. 30 (1977) 141. — **Fig. 31.**

Small, unarmed trees. *Leaves* digitately compound or unifoliolate; petiole terete, with a sheathing base; stipules inconspicuous; leaflets entire or denticulate. *Inflorescence* a terminal panicle of umbellules. Pedicels articulated below the ovary. *Flowers* bisexual or on lower branches male. *Calyx* 5–6-dentate. Petals 5–6, valvate. *Stamens* 5–6, extrorse. Ovary inferior, 2–6-celled. Disk fleshy with the styles united below. *Fruit* ellipsoid or obovate, surmounted by an awl-shaped or conical stylopodium; exocarp fleshy, endocarp crustaceous. Endosperm ruminant.

Distr. 4 *spp.* from India, Burma and southern China to *West Malesia*: 3 *spp.*, Sumatra, Malaya and Java.

Ecol. Lowland and montane rain-forest.

Notes. *Hederopsis* is united with *Macropanax* because the species are very similar in appearance and in their technical characters. The sole difference is the number of cells in the ovary, 2 (or sometimes 3) in *Macropanax* and 5–6 (sometimes 4) in *Hederopsis*. This distinction does not seem adequate to split a few very similar species into distinct genera.

This genus is distinguished from *Pseudopanax* (China, New Caledonia, Tasmania, New Zealand, Chile) by the ruminant endosperm. Cf. PHILIPSON, New Zeal. J. Bot. 3 (1965) 333.

#### KEY TO THE SPECIES

1. Ovary 2-celled.
  2. Ovary broadly campanulate, not ribbed; 'epicalyx' below ovary distinct. Leaf margin usually distinctly serrate. Inflorescence branches usually bearing lateral umbellules. . . . . 1. *M. dispermus*
  2. Ovary narrowly turbinate, strongly ribbed; 'epicalyx' below the ovary absent. Leaf margin entire or minutely dentate. Inflorescence branches usually without lateral umbellules. . . . . 2. *M. concinnus*
1. Ovary 5- or 6-celled . . . . . 3. *M. maingayi*

1. *Macropanax dispermus* (BL.) O. K. Rev. Gen. Pl. 1 (1891) 271; KOORD. Exk. Fl. Java 2 (1912) 716, 717; Atlas 4 (1916) f. 681 & 682 F–P; Fl.

Tjib. 2 (1923) 227; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 14; BACK. & BAKH. f. Fl. Java 2 (1965) 168. — *Aralia*



*disperma* BL. Bijdr. (1826) 872. — *Hedera disperma* (BL.) DC. Prod. 4 (1830) 265. — *Aralia calyculata* Z. & M. in Mor. Syst. Verz. (1846) 41. — *M. floribunda* MIQ. Fl. Ind. Bat. 1, 1 (1856) 764. — *M. oreophilus* MIQ. l.c. 764; Suppl. (1860) 135; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 13; KURZ, For. Fl. Burma 1 (1877) 541; CLARKE, Fl. Br. Ind. 2 (1879) 738; BOERL. Handl. 1 (1890) 644; K. & V. Bijdr. 7 (1900) 16.

Small tree, up to 18 m. *Leaves* dispersed along the shoots; petiole to 25 cm, striate, with a small basal sheath, the connate stipules forming a small ligule within the petiole; leaflets 5–7, petiolules up to c. 5 cm (the lateral shorter); blade elliptic or oblanceolate, usually c. 10–23 by  $2\frac{1}{2}$ –9 cm, gradually tapered to an acute apex, base cuneate, rounded or oblique, margin coarsely dentate or sometimes only finely serrate, glabrous when mature. *Inflorescence* a panicle of umbellules, often stellate-furfuraceous, with a stout rachis to 40 cm and lateral (secondary) branches which terminate in umbellules, and which commonly bear tertiary branches. Pedicels c. 5–7 mm, with a distinct involucre ('epicalyx') around the base of the flower. *Calyx* rim undulate or indistinctly dentate, puberulous. Petals 2–3 mm long. Ovary subglobose, c.  $2\frac{1}{2}$  mm high. Disk fleshy, surmounted by an awl-shaped stylar column, which bifurcates at apex. *Fruit* ovate, 1 by  $\frac{1}{2}$  cm, crowned by the persistent stylar column.

*Distr.* India, Burma, and southern China; in *Malesia*: Sumatra, Malay Peninsula, and throughout Java.

*Ecol.* Mountain rain-forests, 1000–2300 m, in Java especially in Central and East Java.

*Vern.* Java: *panggang puju*, *p. serem*, *p. siju*, *ramo-gentjel*, *tjerem*, S, *pampung*, *sahang*, *tanganan*, J, *konjingal*, Md.

**2. *Macropanax concinnus* MIQ.** Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 220; BOERL. Handl. 1 (1890) 643; K. & V. Bijdr. 7 (1900) 18; KOORD. Exk. Fl. Java 2 (1912) 717; Atlas 4 (1916) f. 682 Q–W. — *M. undulatus* (WALL. ex G. DON) SEEM. J. Bot. 2 (1864) 294, *pro specim. malac.*; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 14; BAKH. & BAKH. f. Fl. Java 2 (1965) 168.

Small tree, up to 15 m. *Leaves* dispersed along the shoots; petiole slender, to 20 cm, with a small basal sheath, the connate stipules forming a small ligule within the petiole; leaflets 5 or 3, petiolules slender, up to c.  $5\frac{1}{2}$  cm (the lateral shorter); blade elliptic, usually c. 7–15 by  $2\frac{1}{2}$ –5 cm, gradually tapered to a caudate-falcate acuminate apex, base narrowly cuneate, or rarely obtuse, often oblique, margin entire or sometimes a few very fine serrations, glabrous, membranous. *Inflorescence* a panicle of umbellules, minutely stellate-pubescent, with a stout rachis to 30 cm, and lateral (secondary) branches which terminate in umbellules; pedicels c. 6–7 mm, only slightly swollen at the articulation.

*Calyx* rim undulate or indistinctly dentate. Petals c. 2 mm long. Ovary narrowly turbinate with distinct longitudinal ribs, c. 2 mm high. Disk fleshy, surmounted by an awl-shaped stylar column. *Fruit* ovate, 8 by 4 mm, crowned by the persistent stylar column.

*Distr.* *Malesia*: widespread in Java, but local and uncommon.

*Ecol.* Damp mountain forests, descending to lower altitudes (400 m) than the preceding species.

*Vern.* *Djampang tjerem*, *panggang puju*, S, *tanganan*, J.

*Notes.* This species has sometimes been identified with *M. undulatus* (WALL. ex G. DON) SEEM. from the Himalayan region, but that species differs in the more verticillate inflorescence branches, the large involucre around the umbellule, the hermaphrodite flowers more confined to the terminal umbellules, and the broader less prominently ribbed fruit. A considerable geographical gap separates the two species.

A specimen collected by GRIFFITH labelled 'Malacca' is perhaps *M. undulatus*, but the locality may be incorrect.

**3. *Macropanax maingayi* (CLARKE) PHILIPSON, comb. nov.** — *Hederopsis maingayi* CLARKE, Fl. Br. Ind. 2 (1879) 739; RIDL. Fl. Mal. Pen. 1 (1922) 888; STONE, Gard. Bull. Sing. 30 (1977) 287, f. 7. — *Arthrophyllum trifoliatum* RIDL. J. Fed. Mal. St. Mus. 7 (1916) 42. — *Hederopsis major* RIDL. Kew Bull. (1929) 124. — **Fig. 31.**

Small tree, up to 15 m. *Leaves* dispersed along the shoots; petiole to 20 cm, striate, with a small basal sheath; leaflets 5, or (below the inflorescence) 3 or 1, petiolule of the central leaflet to 6 cm, of the lateral leaflets much shorter (c. 1 cm); blade elliptic or ovate, up to 20 by 8 cm, base rounded or broadly cuneate, apex acuminate, margin denticulate or nearly entire, membranous or chartaceous. *Inflorescence* a terminal panicle of umbellules, with a stout rachis to 20 cm, terminating in an umbellule and bearing lateral secondary branches (c. 12 cm) which also terminate in umbellules and bear racemously arranged tertiary branches (c. 4 cm) which terminate in umbellules; umbellules terminating the primary and secondary branches with hermaphrodite flowers, those terminating the tertiary branches smaller and apparently mostly functionally male. *Flowers* of small umbellules usually 5-merous, of larger umbellules usually 6–7-merous, pedicels c. 1 cm at anthesis, slightly elongating in fruit. *Calyx* rim obscurely dentate. Petals of terminal flowers c. 3 mm long, fleshy. Ovary subglobose, c. 2 mm high; disk fleshy surmounted by the style arms which become divergent in their upper part at anthesis. *Fruit* enlarging to a drupe 2 by 1 cm with a persistent calyx rim and a prominent conical stylopodium tapering into the stylar column bearing the recurved distal parts of the styles.



Fig. 31. *Macropanax maingayi* (CLARKE) PHILIPSON. *a.* Leaf and upper branches of inflorescence,  $\times \frac{2}{5}$ , *b.* flower bud and CS of ovary,  $\times 2$ , *c.* flower,  $\times 2$ , *d.* fruit, slightly enlarged (Phytochem. Surv. Mal. 2519). Drawn by W. R. PHILIPSON.



Distr. Tonkin; in *Malesia*: Malay Peninsula (from Kedah southwards) and Central Sumatra (East Coast Res. and Mt Kerintji).

Ecol. Uncommon, in forest, up to 1050 m.

Note. The trunk may have small buttresses, the bark is rugose with large lenticels, and produces a watery exudate when cut. The flowers are greenish yellow.

## 12. ANAKASIA

W. R. PHILIPSON, *Blumea* 21 (1973) 87, fig. on p. 88. — **Fig. 32.**

Shrub with large, simple, exstipulate leaves. *Inflorescence* axillary; rachis bearing racemously arranged umbellules. Pedicels very short with an articulation below the flower. *Calyx* a short rim with minute lobes. Petals 5 or 6, valvate, triangular. *Stamens* 5 or 6, filaments thick, anthers large, dorsifixed. Ovary inferior, broadly obconic, (4–)5–6-celled. Disk fleshy with (4–)5–6 stylar arms. *Fruit* broadly obovoid, strongly ribbed when dry; exocarp fleshy. Pyrenes compressed, crustaceous; endosperm smooth.

Distr. *Malesia*: West New Guinea. Monotypic.

Note. The large, simple, oblanceolate leaves clustered at the ends of the branches recall *Meryta*, but the flowers do not share the highly distinctive features of that genus. The floral and fruit characters are not unlike those of *Polyscias* (e.g. there is an articulation below the flower, the style arms are free, and the endosperm is smooth), but the general facies is unlike that genus, and this, together with the distinctive inflorescence and leaf, make the plant quite distinct from any species of *Polyscias*.

1. *Anakasia simplicifolia* W. R. PHILIPSON, *Blumea* 21 (1973) 87, fig. on p. 88. — **Fig. 32.**

Glabrous shrub, 5 m, branches marked with prominent lenticels. *Leaves* crowded at the ends of the branches, sessile or with a very short petiole, lanceolate, up to 135 by 18 cm, narrowed gradually to the base, apex acuminate, margin entire or undulate, midrib prominent, lateral veins arching upwards, reticulation rather indistinct. *Inflorescence* rachis simple or forked, to 70 cm, at maturity 5 mm  $\varnothing$ , bearing small lanceolate bracts. Peduncles arising from the axils of all but the lowest bracts, 3–4 mm long, elongating to c. 15 mm in fruit. Umbellules with c. 11 minute bracts. *Flower buds* when dry c. 3 mm long. *Calyx* rim with 5–6 minute teeth. Petals slightly fleshy, 2 mm long. *Stamens* 5–6, filaments broad; anthers 4-celled,  $\frac{3}{4}$  mm long. Ovary glabrous. Disk with a central boss formed by closely appressed subulate arms which soon

recurve and spread beyond the calyx. *Fruit* with (4–)5–6 prominent ridges when dry, c. 2 by  $1\frac{1}{2}$  cm, with the persistent style arms in a terminal depression.

Distr. *Malesia*: West New Guinea (Vogelkop Peninsula and near Babo).

Ecol. Primary forest near sea-level.

Note. BECCARI described (*in sched.*) the inflorescence branches as erect in flower and reflexed in fruit. He noted that the outer flowers of the umbellules are probably male and those at the centre female, though he could not be certain of this. His observations cannot be confirmed from the material available. Evidently all flowers are structurally hermaphrodite, but all developing fruits seen are attached to central pedicels. The corolla is green and soon falls, the disk yellow, the anthers cream, and the mature fruit blue (azure-violet) and aromatic.

## 13. BRASSAIOPSIS

DECNE & PLANCH. *Rev. Hort.* IV, 3 (1854) 106; BTH. in B. & H. *Gen. Pl.* 1 (1865) 945; CLARKE, *Fl. Br. Ind.* 2 (1879) 735; BOERL. *Handl.* 1 (1890) 643; HARMS in E. & P. *Nat. Pfl. Fam.* 3, 8 (1894) 42; KING, *J. As. Soc. Beng.* 67, ii (1898) 61; NGOC-SANH BUI, *Adansonia* 6 (1966) 437, pl. 1 (map); HUTCH. *Gen. Fl. Pl.* 2 (1967) 79; STONE, *Gard. Bull. Sing.* 30 (1977) 280. — *Araliopsis* KURZ, *Rep. Andam.* (1870) 39, *nom. inval.*, in *synon.*, non ENGLER, 1896. — *Wardenia* KING, *J. As. Soc. Beng.* 67, ii (1898) 60; HARMS in E. & P. *Nat. Pfl. Fam. Nachtr.* 2

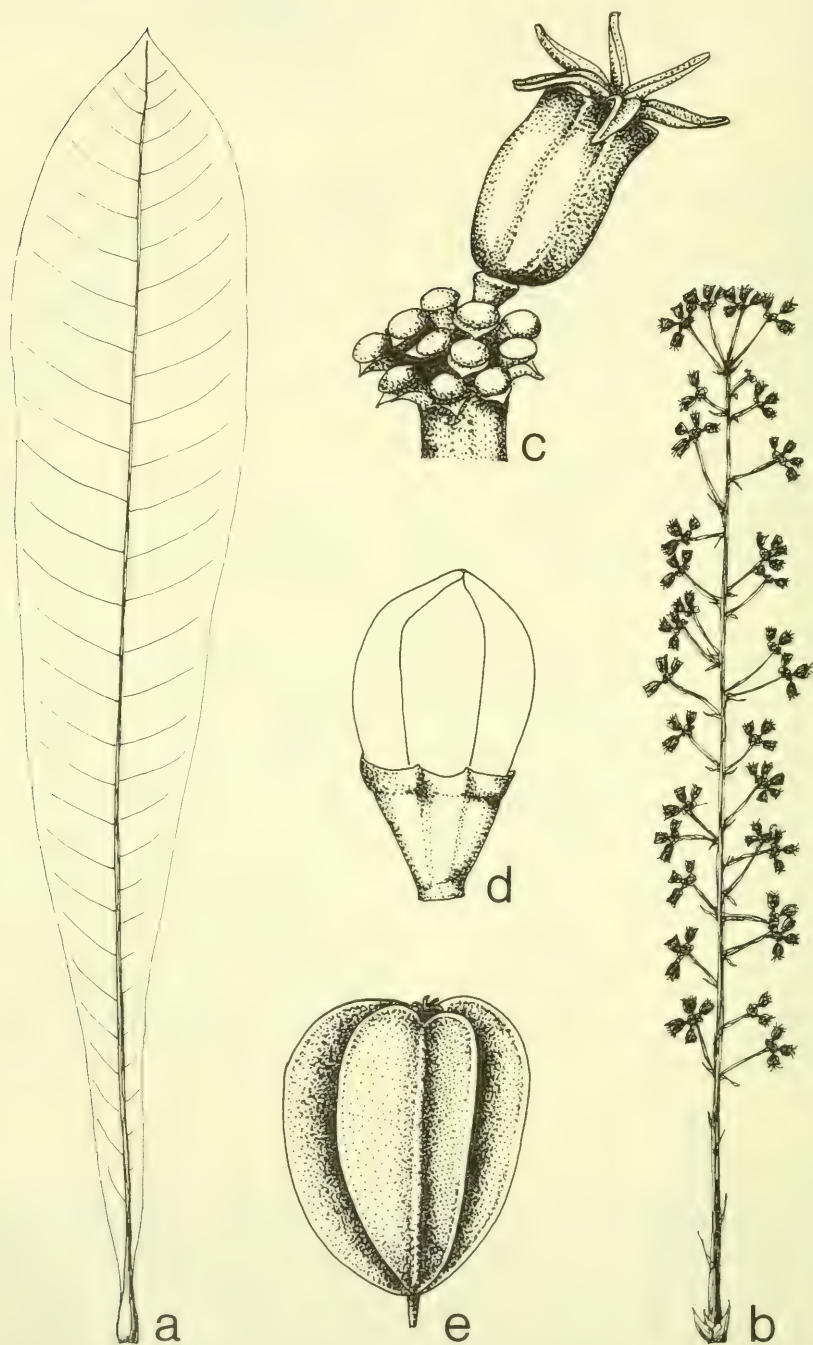


Fig. 32. *Anakasia simplicifolia* PHILIPSON. a. Leaf,  $\times \frac{1}{17}$ , b. inflorescence,  $\times \frac{1}{3}$ , c. single umbellule with an immature fruit, d. flower bud,  $\times 12$ , e. immature fruit,  $\times 2$  (BECCARI PP 282).



(1900) 51; RIDL. Fl. Mal. Pen. 1 (1922) 887; HUTCH. Gen. Fl. Pl. 2 (1967) 81; cf. FRODIN, Misc. Rec. Found. Fl. Males. 3 (1973) 8. — *Euaraliopsis* HUTCH. Gen. Fl. Pl. 2 (1967) 80, 624. — *Pseudobrassaiopsis* BANERJEE, J. Bomb. Nat. Hist. Soc. 72 (1975) 71. — **Fig. 33, 34.**

Shrubs or trees, usually prickly and tomentose. *Leaves* digitately compound, palmately lobed or simple, with a sheathing base and a usually bicuspid ligule; petiole terete. *Inflorescence* usually a terminal panicle of umbellules, often with persistent small bracts; pedicel not articulated below the ovary. *Calyx* rim 5-dentate. Petals 5, valvate. *Stamens* 5, extrorse. Ovary inferior, 2-celled; disk shallow; styles united into a usually long column. *Fruit* globose, exocarp fleshy, endocarp chartaceous; seed 2, not compressed, endosperm smooth.

Distr. More than 20 *spp.*, extending from India, Tibet and southern China to *West Malesia*: Sumatra, Malay Peninsula and W. Java. In Malesia 6 *spp.*, 1 endemic in Sumatra, 3 endemic in the Malay Peninsula, 2 in Indo-Malaya.

Ecol. Understorey of damp evergreen forest, mostly in mountainous districts, up to 2400 m.

Notes. A genus characterized by the 2-celled ovary, columnar style, and non-articulated pedicel, combined with leaves which may be either entire, palmately lobed, or digitately compound. Possibly close to *Trevesia*, which is similar vegetatively, but which has more massive inflorescences and ovaries with more numerous cells.

In dividing the species into two genera merely on the basis of leaf shape, HUTCHINSON *l.c.* fragmented what appears to be a coherent assemblage.

#### KEY TO THE SPECIES

1. Inflorescence shorter than the petioles (or at most about equal to them). Leaves palmately lobed, but variable in the variety . . . . . 1. *B. sumatrana*
1. Inflorescence much longer than the petioles.
  2. Leaves simple, entire, minutely and remotely dentate.
    3. Leaf base subcordate; blade to 35 cm or more long; petioles *c.* 15 cm, 5 mm  $\varnothing$  . . . 2. *B. simplex*
    3. Leaf base cuneate or rounded; blade to 25 cm long; petioles *c.* 7 cm, 2 mm  $\varnothing$  . . . 3. *B. minor*
  2. Leaves palmately lobed or digitately compound (occasionally some simple).
    4. Leaves palmately lobed . . . . . 4. *B. polyacantha*
    4. Leaves digitately compound.
      5. Branches of the inflorescence bearing several umbellules racemosely (as well as one at end); umbellules with *c.* 25–35 flowers . . . . . 5. *B. glomerulata*
      5. Branches of the inflorescence bearing a terminal umbellule only (or occasionally with separate flowers below it); umbellule with *c.* 10–13 flowers . . . . . 6. *B. elegans*

1. *Brassaiopsis sumatrana* RIDL. J. Fed. Mal. St. Mus. 8, 4 (1917) 43. — *Kalopanax sumatranum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 17, heterotypic; BOERL. Handl. 1 (1890) 647; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 51. — ? *Kalopanax resectum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 18, see note below. — *Euaraliopsis sumatrana* (RIDL.) HUTCH. Gen. Fl. Pl. 2 (1967) 624.

#### *var. sumatrana.*

Shrub or small tree, to 15 m, with stout prickly branches, rufous-tomentose in its younger parts. *Leaves* palmately lobed, clustered at the ends of the shoots; petiole *c.* 15–32 cm, striate, sometimes with prickles, with an enlarged basal sheath and a small bicuspid ligule; blade rounded, cordate, *c.* 14–22 by 20–28 cm, palmately 5–7-lobed,

lobes elliptic acuminate, midrib prominent and lateral veins widely spaced and arched-ascending, margin irregularly spinulose-serrate. *Inflorescence* a short, rufous-tomentose panicle, arising below the leaves (actually terminal but overtopped by sympodial innovations); rachis *c.* 4–6 cm, lateral branches ascending, *c.* 2–4 cm, subtended by small linear bracts and sometimes branching to the third degree; umbellules with *c.* 8–20 flowers; pedicels *c.* 1 cm long, subtended by numerous minute bracts. *Calyx* a minute rim with 5 indistinct teeth. Petals 5, triangular, 2½ mm long. Stamens 2 mm long, anthers oblong, 1 mm long. Ovary obconic, *c.* 2 mm high; disk fleshy, cushion-shaped, surmounted by a slender awl-shaped stylar column. *Fruit* subglobose, *c.* 8 mm high, with a persistent calyx-rim and stylar column.



Fig. 33. *Brassaiopsis elegans* RIDL. a. Habit,  $\times \frac{2}{5}$ , b. fruit and ditto in CS,  $\times 4$  (Kloss 1912). Drawn by P. PRENDERGAST.



Distr. *Malesia*: West Sumatra (Mts Kerintji, Merapi, Singalang).

Ecol. Montane, evergreen forest, 1500–2400 m. Vern. *Semontong*, Karo.

Notes. The foliage is similar to that of *B. polyacantha* and of *Trevesia sundaica*, but the small inflorescence is distinctive. The prickles persist on the older branches and the trunk. The petals and filaments are white, the anthers light purple, and the disk yellow.

*Kalopanax resectum* MIQ. *l.c.*, described on a KORTHALS collection from Sumatra, possibly belongs here, but the inflorescence may be larger and most leaves are decidedly digitately compound. Possibly it represents a hybrid between *B. sumatrana* and *B. glomerulata*.

var. *variaefolia* PHILIPSON, var. nov. — *B. ovalifolia* RIDL. J. Fed. Mal. St. Mus. 8, 4 (1917) 43.

*Frutex* var. *sumatrana humilior et tenerior, foliis secus ramis dispersis, inermis. Folia minora (10–20 cm longa) forma variantia etiam in eodem ramo, vel simplicia et ovata, vel profunde bi- vel trilobata, vel digitatim composita.* — *Typus*: W. MEIJER 7200 (L), Mt Sago near Pajakumbuh, W. Sumatra, 1000–1200 m, 8–VIII–1957.

A smaller, more delicate and unarmed shrub than var. *sumatrana*, with the leaves scattered along the branches. Leaves smaller (10–20 cm long) and variable in shape, even on the same branch, being either simple and ovate, or deeply bi- or trilobed, or digitately compound.

Distr. *Malesia*: Central West Sumatra.

Ecol. Montane, evergreen forest, 1000–1200 m.

Note. It is possible that RIDLEY was correct in regarding this as a distinct species, but the size and shape of the inflorescence links it with *B. sumatrana*, and the variable form of the leaf suggests that it may be no more than an extreme form of *B. sumatrana*. Nevertheless, typical forms of that species, with their stout prickly stems and rather coarse palmately lobed leaves, are very distinct. On the evidence available it is not possible to decide whether this variety consists of shade and/or juvenile forms of *B. sumatrana*, or whether it should constitute a distinct species.

2. *Brassaiopsis simplex* (KING) STONE, Gard. Bull. Sing. 30 (1976) 282, f. 3. — *Wardenia simplex* KING, J. As. Soc. Beng. 67, ii (1898) 60; HARMS in E. & P. Nat. Pfl. Fam. Nachtr. 2 (1900) 51; RIDL. Fl. Mal. Pen. 1 (1922) 887; HUTCH. Gen. Fl. Pl. 2 (1967) 81; PHILIPSON, J. Linn. Soc. Bot. 63, Suppl. (1970) 90.

Shrub, to 5 m high, branches prickly, rufous-tomentose in its younger parts. Leaves large, simple, coriaceous, clustered towards the tips of the branches; petiole *c.* 14–20 cm, stout, striate, with a basal sheath and a short, bicuspid ligule; blade ovate, *c.* 35–40 by 12–18 cm, apex shortly acuminate, base slightly cordate, rufous-stellate

hairs persistent beneath, midrib prominent, lateral veins very widely spaced, arched ascending, margin minutely dentate. Inflorescence a panicle of umbellules; rachis *c.* 10–20 cm; lateral branches reflexed, 5–12 cm, subtended by small lanceolate bracts and often bearing 1–2 bracts from which tertiary branches arise; umbellules with *c.* 10–20 flowers; pedicels  $1\frac{1}{4}$ –2 cm, slender, subtended by numerous minute bracts. Calyx a narrow rim with 5 indistinct teeth. Petals 5, falling as a calyptra. Stamens 2 mm long, anthers oblong. Ovary obconic, *c.* 2 mm high, disk cushion-like, surmounted by an awl-shaped stylar column  $1\frac{1}{2}$  mm long. Fruit globose, fleshy, *c.* 5 mm  $\varnothing$ , with a persistent calyx rim and a stylar column *c.* 2 mm long.

Distr. *Malesia*: Malay Peninsula (Perak, Selangor).

Ecol. In open bamboo forest, 100–800 m.

Note. Originally described as a distinct genus because of its supposedly 1-celled ovary. RIDLEY (1922) did not include this feature in his description. He distinguished *Wardenia* from *Brassaiopsis* because of its simple leaves, but several species of *Brassaiopsis* from further north also have undivided leaves. Both HARMS (1900) and HUTCHINSON (1967) accepted the original statement that the ovary is 1-celled at the time of flowering, but I found the ovary to be 2-celled even in the young state (1970, *l.c.*).

3. *Brassaiopsis minor* STONE, Gard. Bull. Sing. 30 (1976) 282, f. 5.

Small shrub, *c.* 60 cm, with very few small prickles, rufous tomentose on its young parts. Leaves simple, spaced towards the ends of the branches, subcoriaceous; petiole 5–8 cm, *c.* 2 mm  $\varnothing$ , with a basal sheath and a small ligule; blade elliptic or ovate 20–26 by 10–12 cm, apex shortly acuminate, base rounded to cuneate, rufous stellate hairs persistent beneath, midrib prominent, lateral veins widely spaced, arched ascending, margin minutely and remotely dentate. Inflorescence: peduncle short, bearing lanceolate bracts; umbellules on short lateral branches, with 15–20 flowers on slender pedicels *c.*  $1\frac{1}{2}$  cm long, subtended by minute puberulent bracts. Calyx with 5 indistinct teeth. Ovary rotund, surmounted by a slender stylar column 1 mm long.

Distr. *Malesia*: Malay Peninsula (Trengganu).

Ecol. Humid situations in lowland to montane forest, to 1100 m.

4. *Brassaiopsis polyacantha* (WALL.) BANERJEE, Ind. For. 93 (1967) 341; STONE, Gard. Bull. Sing. 30 (1977) 282. — *Hedera polyacantha* WALL. Pl. As. Rar. 2 (1831) 82, t. 190. — *Panax palmatum* ROXB. [Hort. Beng. (1814) 21, *nomen*;] Fl. Ind. ed. Carey 2 (1832) 74. — *B. palmata* (ROXB.) KURZ, J. As. Soc. Beng. 39, ii (1870) 77; CLARKE, Fl. Br. Ind. 2 (1879) 735; KING, J. As. Soc. Beng. 67, ii (1898) 61; RIDL. Fl. Mal. Pen. 1 (1922) 887. —



Fig. 34. *Brassaiopsis polyacantha* (WALL.) BANERJEE. In flower at Kuala Lumpur (Photogr. PHILIPSON, 1975).

*Euaraliopsis palmata* (ROXB.) HUTCH. Gen. Fl. Pl. 2 (1967) 80. — *Pseudobrassaiopsis polyacantha* (WALL.) BANERJEE, J. Bomb. Nat. Hist. Soc. 72 (1975) 72. — Fig. 34.

A small sparsely branched tree with buttresses, to c. 13 m; branches prickly, rufous-tomentose on the younger parts and persisting on the leaves and inflorescence. *Leaves* palmately lobed, clustered at the ends of the shoots; petiole to c. 70 cm, longitudinally grooved, with an enlarged basal sheath and a pair of small stipular processes; blade rounded, cordate, c. 18–30 by 20–40 cm, deeply palmately 5–9-lobed, lobes oblong-elliptic, acuminate, midrib prominent and main lateral veins widely spaced and arched-ascending, margin inconspicuously serrate. *Inflorescence* a large panicle often overtopped by sympodial innovations; rachis c. 40–60 cm, lateral branches c. 8–15 cm, subtended by very small caducous bracts and often bearing a pair of minute bracts near the middle, from which short tertiary branches may arise, branches terminating in spherical umbellules; umbellules with c. 15–25 flowers, subtended by numerous minute bracts; pedicels  $\frac{3}{4}$ –1 $\frac{1}{4}$  cm.

*Calyx* of 5 small teeth, rusty tomentose. *Petals* 5, triangular, 2 $\frac{1}{2}$  mm long. *Stamens* 2 mm long, anthers oblong, 1 mm. *Ovary* obconic, c. 2 mm high; disk fleshy, cushion-shaped, surmounted by an awl-shaped stylar column 1 $\frac{1}{2}$  mm long. *Fruit* globose, 6–8 mm  $\varnothing$ , with a persistent calyx rim and stylar column.

*Distr.* Widespread in SE. Asia (India, Nepal, Burma, Andamans); in *Malesia*: Malay Peninsula (from Kedah to Selangor and Pahang).

*Ecol.* Montane rain-forest, to c. 1800 m.

*Note.* The inflorescence is similar to that of *B. glomerulata* but the leaves of these two species cannot be confused.

**5. *Brassaiopsis glomerulata* (BL.) REGEL**, Gartenfl. 12 (1863) 275, t. 411; KOORD. Exk. Fl. Java 2 (1912) 715; Atlas 4 (1916) f. 674; Fl. Tjib. 2 (1923) 226; BACK. & BAKH. f. Fl. Java 2 (1965) 167; NGOC-SANH BUI, *Adansonia* 6 (1966) 437; STONE, Gard. Bull. Sing. 30 (1977) 282. — *Aralia glomerulata* BL. Bijdr. (1826) 872. — *Hedera glomerulata* (BL.) DC. Prod. 4 (1830) 265; Hook. Bot. Mag. 80 (1854) t. 4804. — *B. speciosa* DECNE & PLANCH.



Rev. Hort. 4, 3 (1854) 106; BOERL. Handl. 1 (1890) 643; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 43, f. 1 B; K. & V. Bijdr. 7 (1900) 8; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 11. — *Macropanax glomerulatum* (BL.) MIQ. Fl. Ind. Bat. 1, 1 (1856) 764. — *Macropanax cyrtostylum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 13. — *B. cyrtostyla* (MIQ.) SEEM. J. Bot. 2 (1864) 293.

Tree up to 10 m, with stout often sinuous branches prickly in their upper parts, the young parts of the shoots and inflorescences rufous-tomentose. *Leaves* digitately compound, clustered at the ends of the shoots; petiole c. 25–60 cm, with an expanded basal sheath with two aculeate stipules; leaflets 5–9, petiolules c. 8–10 cm (the laterals shorter), blade elliptic-oblong, c. 15–25 by 6–10 cm, apex acuminate, base broadly cuneate to rounded, midrib prominent, lateral veins widely spaced, arched-ascending, margin serrulate. *Inflorescence* a large panicle; rachis 30–60 cm, lateral branches c. 20–30 cm, with umbellules arranged racemously along them on peduncles c. 2–5 cm long, bracts numerous, lanceolate, c.  $\frac{1}{2}$  cm long, mostly persistent; umbellules with c. 25–35 flowers, pedicels 1–1 $\frac{1}{4}$  cm, subtended by numerous minute ferruginous bracts. *Calyx* of 5 small teeth. Petals 5, triangular, 3–4 mm long. Filaments 2–2 $\frac{1}{2}$  mm, anthers oblong, 1 mm. Ovary obconic at anthesis, c. 2 mm high; disk fleshy, cushion-shaped, surmounted by an awl-shaped stylar column. *Fruit* globose, 6–7 mm high, with a persistent calyx rim and a stylar column usually 2 mm long but occasionally much shorter (even in the same inflorescence).

Distr. India to SW. China; in *Malesia*: Malay Peninsula (Pahang, Negri Sembilan), Sumatra, W. Java.

Ecol. Humid, evergreen, montane rain-forest, 1200–2200 m.

Vern. Sumatra: *kayu aro*, M (Kerintji); Java: *panggang*, *p. pujut* (or *puju*), *p. ranti* (or *ranto*), S.

Note. Juvenile plants bear leaves which are simple, irregularly lobed, or with 2, 3 or 5 leaflets. The flowers are pale yellowish cream. The cut stems exude a yellowish sap.

6. *Brassaiopsis elegans* RIDL. J. Linn. Soc. Bot. 41 (1913) 291; Fl. Mal. Pen. 1 (1922) 888; STONE, Gard. Bull. Sing. 30 (1977) 282, f. 4. — Fig. 33.

Shrub, stems with few to many prickles, young parts rufous-tomentose, becoming glabrous. *Leaves* digitately compound, or occasionally simple; petiole c. 14 cm, striate, with a small basal sheath and a short, bicuspid ligule; leaflets 3–5 (or 1), petiolules c. 3 cm (laterals shorter); blade elliptic, c. 12–16 by 4–5 cm, apex long acuminate, base cuneate, midrib prominent, lateral veins widely spaced, arched-ascending, margin minutely denticulate. *Inflorescence* a lax gracefully pendent raceme of umbellules; rachis c. 23 cm, lateral branches c. 5 cm, subtended by small lanceolate bracts and bearing 1–2 minute bracts near the middle, terminating in spherical umbellules and occasionally with separate flowers arising below the apex; umbellules with c. 10–13 flowers, subtended by numerous minute bracts; pedicels at anthesis c.  $\frac{1}{2}$  cm elongating to c. 1 $\frac{1}{4}$ –1 $\frac{1}{2}$  cm in fruit. *Calyx* of 5 minute teeth. Petals 5, triangular, 2 $\frac{1}{2}$  mm long. Stamens 2 mm long, anthers oblong. Ovary obconic, c. 2 mm high; disk fleshy, surmounted by an awl-shaped stylar column. *Fruit* globose, 6 mm high, with a persistent calyx rim and stylar column.

Distr. *Malesia*: Malay Peninsula (Selangor, Pahang), very local.

Ecol. Montane, evergreen rain-forest, 800 m.

#### 14. TREVESIA

VISIANI, Giorn. Tosc. Sc. Med. 1 (1840) 72; Mem. Accad. Torino II, 4 (1842) 262; MIQ. Fl. Ind. Bat. 1, 1 (1856) 747; Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 10; BTH. in B. & H. Gen. Pl. 1 (1865) 942, *p.p.*; BOERL. Ann. Jard. Bot. Btzg 6 (1887) 107; Handl. 1 (1890) 639; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 32; KING, J. As. Soc. Beng. 67, ii (1898) 57; KOORD. Atlas 4 (1916) f. 664–666; HUTCH. Gen. Fl. Pl. 2 (1967) 71. — *Petasula* NORONHA, Verh. Bat. Gen. 5 (1790) ed. 1, art. 4: 3, *p.p.*, cf. STEEN. Regn. Veget. 71 (1970) 376. — Fig. 35, 36.

Shrubs or trees, unarmed or prickly, tomentose at least on young parts; buds enclosed in cataphylls. *Leaves* large, palmately lobed or digitately compound, stipules forming a bicuspid ligule within the terete petiole. *Flowers* in umbellules which are arranged racemously along a rachis or in panicles; pedicels not articulated below the ovary. *Calyx* a small rim. Petals 7–12, valvate, often falling at



Fig. 35. *Trevesia burckii* BOERL. a. Habit,  $\times \frac{1}{5}$ , b. flower,  $\times 2$ , c. fruit and ditto in CS,  $\times 1\frac{1}{2}$  (a RAHMAT SI TOROES 5048, b YAPP 99, c RAHMAT SI TOROES 5049). Drawn by P. PRENDERGAST.



anthesis as a calyptra. *Stamens* as many as the petals; anthers large ovoid, dorsifixed, introrse, filament strap-like. Ovary inferior, broadly obconic or subglobose, 7–12-celled; disk rising gradually to a central boss formed by the united styles. *Fruit* globose or ovoid, crowned by the disk and prominent styler column; pyrenes coriaceous, compressed, endosperm smooth.

Distr. 6  *spp.* ranging from eastern India and SW. China to Malesia; 5 of the species occur in *W. Malesia*: Sumatra, Malay Peninsula, Java, Borneo, Lesser Sunda Is. (Lombok).

Formerly erroneously credited to the Philippines, *cf.* MERRILL, *En. Philip.* 3 (1923) 237.

Ecol. Primary rain-forest and second growth, especially in humid, shady localities.

Note. The genus comprises three well known species, each occupying distinct areas, except that the ranges of two overlap in Sumatra. In addition there are three very local and imperfectly known species.

#### KEY TO THE SPECIES

1. Leaves digitately compound.
  2. Petiolules connected by a web of tissue for most of their length . . . . . 1. *T. burckii*
  2. Petioles free. Continental SE. Asia. . . . . *T. palmata* (DC.) VIS.
1. Leaves palmately lobed.
  3. Inflorescence branches and petioles densely covered with long red setae . . . . . 2. *T. rufo-setosa*
  3. Inflorescence branches not as above (but sometimes setulose, furfuraceous, pubescent or glabrous).
    4. Flowers sessile or subsessile . . . . . 3. *T. beccarii*
    4. Flowers pedicelled.
      5. Ovary *c.* 14-celled, pedicels stout, *c.* 4 mm  $\varnothing$  . . . . . 4. *T. sundaica*
      5. Ovary *c.* 8–10-celled, pedicels more slender, 1–2 mm  $\varnothing$  . . . . . 5. *T. arborea*

1. *Trevesia burckii* BOERL. *Ann. Jard. Bot. Btzg* 6 (1887) 110, pl. 12(–14); *Handl.* 1 (1890) 649; MERR. *En. Born.* (1921) 456; MASAMUNE, *En. Phan. Born.* (1942) 566. — *T. palmata* (DC.) VIS. *var. cheiranthia* CLARKE, *Fl. Br. Ind.* 2 (1879) 732; KING, *J. As. Soc. Beng.* 67, ii (1898) 58. — *T. cheiranthia* (CLARKE) O. K. Rev. *Gen. Pl.* 1 (1891) 272; RIDL. *Fl. Mal. Pen.* 1 (1922) 882. — **Fig. 35.**

Shrub or small, sparsely branched tree up to 10 m, branches stout with small prickles, young parts rufous-furfuraceous, cataphylls prickly. *Leaves* crowded at the ends of the shoots, digitately compound; leaflets usually 7–9; petioles *c.* 60 cm, striate, sometimes with small prickles or bristles, dilated into a clasping base, ligule with two lanceolate lobes; petiolules united for all or most of their length by a foliaceous web; leaflets oblong-lanceolate or elliptic, up to 30 by 10 cm, apex acuminate, base cuneate or rounded, margin finely serrate especially in the upper part, principal veins arched-ascending, prominent. *Inflorescence* a large terminal panicle, often overtopped by lateral shoots; rachis to 60 cm, slightly prickly or not, bearing branches along its length and usually ending an umbel of branches, bracts caducous or persistent; secondary branches (peduncles) *c.* 10–18 cm, sometimes with 1 or few bracts along their length and terminating in spherical umbellules of 40–50 flowers; pedicels *c.* 20–35 mm, slender. *Calyx* an irregular obsolete rim. Corolla hemispherical, *c.* 6 mm high, falling as a calyptra, petals *c.* 7–10. *Stamens c.* 7–10, filament flattened *c.* 2½ mm, anthers broadly triangular, *c.* 3 mm

long. Ovary at anthesis broadly obconic, usually rufous-furfuraceous, *c.* 7–10-celled; disk broadly conical surmounted by the connate styles, stigmas slightly swollen. *Fruit* subglobose 1½ by 1¼ cm, surmounted by the stylopodium and connate styles.

Distr. *Malesia*: Sumatra, Malay Peninsula (from Kedah southwards), Borneo (Sarawak).

Ecol. Primary rain-forest, mostly below 500 m, rarely up to 1000 m.

Vern. Sumatra: *tapa arimau, tada lada*, M; Malaya: *kakabu, tapak itek, t. rimau*, M.

Note. The stamens are described as cream on an orange disk. Seedling plants have leaves which are palmately lobed or entire.

2. *Trevesia rufo-setosa* RIDL. *J. Str. Br. R. As. Soc. n.* 86 (1922) 294; *Fl. Mal. Pen.* 1 (1922) 883.

A shrub with stout prickly stems, young parts, petioles and inflorescence densely covered with red-brown flat setae. *Leaves* palmately lobed, clustered at the ends of the shoots; petioles *c.* 60 cm, dilated into a clasping base with a bicuspid ligule; blade *c.* 30 by 30 cm, with 7 lobes; lobes *c.* 20 by 9 cm, elliptic, shortly cuspidate, midveins and widely spaced arched-ascending laterals prominent, margin with many upwardly directed spinulous teeth. *Inflorescence* terminal; rachis flexuous, *c.* 20 cm, bearing lateral umbellules, bracts linear *c.* 12 mm; pedicels short. *Flowers* heterosexual. *Calyx* rim obscure. Petals 5, triangular, 6 mm long, setose on the outside, spreading. *Stamens* 5. Ovary in the fertile flowers obconic,



Fig. 36. *Trevesia sundaica* MIQ. in mixed evergreen mountain forest in E. Java at Sarangan, c. 1200 m altitude, with *Quercus* (Photogr. JESWIET, 1925).



setose, 5-celled; disk with cylindrical projecting stylar column. *Fruit* unknown.

Distr. *Malesia*: Malay Peninsula (Selangor: Semangkok Pass).

Ecol. Montane forest, at c. 800 m.

**3. *Trevesia beccarii* BOERL.** Ann. Jard. Bot. Btzig 6 (1887) 110, pl. 11.

Shrub, c. 3 m, with stout prickled stems. *Leaves* palmately lobed, clustered at the ends of the branches; petiole c. 50 cm, hirsute with short patent bristly hairs when young, some persisting, dilated into a clasping spinulose base with a bicuspid ligule; blade c. 30 by 40 cm, with 7–9 lobes, base cordate, lobes c. 15 by 7 cm, broadly elliptic-oblong, apex rather blunt, rusty stellate-pubescent when young, sometimes persisting, mid-veins and rather numerous arched-ascending lateral veins prominent, margin irregularly serrate. *Inflorescence* when young hirsute like the petioles, sometimes persistent; rachis c. 90 cm, bearing many lateral branches (peduncles) along its length, bracts lanceolate, caducous; peduncles c. 5–15 cm with some caducous, linear bracts along their length and around the base of the umbellules (capitula). Capitula of c. 10–20 sessile (or subsessile) flowers. *Calyx* rim short, undulate. Corolla conical in bud, falling as a calyptra. Stamens 10–12, anthers oblong, filaments stout. Ovary obconic, angular from contact with neighbouring flowers, 10–12-celled; disk broadly conical; surmounted by the massive connate styles, stigmas slightly swollen. *Fruit* obconic angular from mutual pressure, c. 10 by 7 mm.

Distr. *Malesia*: West Central Sumatra.

Ecol. Forest, ascending to 1200 m.

Vern. *Likabau*, M.

**4. *Trevesia sundaica* MIQ.** Pl. Jungh. 3 (1855) 420; Fl. Ind. Bat. 1, 1 (1856) 747; DE VRIESE, Pl. Ind. Or. (1857) 81; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 11; BOERL. Ann. Jard. Bot. Btzig 6 (1887) 111, pl. 12 (16); Handl. 1 (1890) 649; K. & V. Bijdr. 7 (1900) 4, incl. var. *glomerata* K. & V. l.c. 5; KOORD. Exk. Fl. Java 2 (1912) 710; Atlas 4 (1916) f. 664–666; Fl. Tjib. 2 (1923) 222; BAKH. f. & OOSTSTR. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 159, p. 4; BACK. & BAKH. f. Fl. Java 2 (1965) 163. — *Aralia palmata* REINW. ex BL. Cat. Btzig (1823) 43, *nomen*; ex DE VRIESE, Pl. Ind. Or. (1857) 82, *nomen in synon.*; BOERL. Ann. Jard. Bot. Btzig 6 (1887) 111, *in synon.*, non LAMK, 1783, nec LOUR. 1790. — *Sciadophyllum palmatum* BL. Bijdr. (1826) 875, non *T. palmata* (ROXB.) VIS. 1842. — *Aralia reinwardtiana* STEUD. Nomencl. 1 (1840) 118, *nomen*. — *Gastonia sundaica* (MIQ.) BAILL. Hist. Pl. 7 (1880) 161, f. 202. — *Actinophyllum palmatum* BL. ex BOERL. Ann. Jard. Bot. Btzig 6 (1887) 111, *in synon.* — Fig. 36.

Shrub or small, sparsely branched tree, up to

8 m; branches stout, with small prickles, young parts stellate-tomentose, becoming glabrous, buds with cataphylls. *Leaves* palmately lobed, clustered at the ends of the branches; petiole striate, c. 50–60 cm, unarmed or with a few prickles near the base, dilated with a clasping, heavily lenticellate base, ligule bicuspid; blade c. 60 by 60 cm, with 7–11 lobes, base cordate, lobes c. 30 by 40 cm, elliptic-oblong, apex acute to acuminate, separated by wide sinuses, mid-veins and widely spaced arched-ascending lateral veins prominent, margin serrate, occasionally irregularly incised. *Inflorescence* arising among or below the leaves, a raceme of umbellules, at first rusty pubescent, glabrescent; rachis up to 60 cm, often much shorter, bearing branches along its length and ending in an umbel, bracts lanceolate, caducous; secondary branches (peduncles) c. 8–16 cm, bearing small bracts along their length and around the umbellules; umbellules of c. 20–35 flowers, pedicels c. 2–5 cm, lateral umbellules sometimes bearing small sterile (male) flowers. *Calyx* rim very short, undulate. Corolla hemispherical in bud, c. 6 mm high, falling as a calyptra, petals 8–12. Stamens 8–12, filaments stout, anthers ovate, c. 3 mm long. Ovary at anthesis broadly obconic, rufous-furfuraceous, c. 8–10-celled; disk broadly conical passing into the stylar column. *Fruit* semiglobose,  $1\frac{1}{4}$ – $1\frac{1}{2}$  cm  $\varnothing$ , surrounded by the stylopodium and connate styles.

Distr. *Malesia*: Sumatra, Java, Lesser Sunda Is. (Lombok).

Ecol. Evergreen rain-forest, especially in ravines, ascending to 1500 m.

Vern. Sumatra: *ahab*, *tapa arimau*, M; Java: *borang*, *djemporang*, *dorang*, *gabus*, *gorang*, *lontanglanting*, *panggang*, *p. lembur*, *p. puju*, *p. tjutjuk*, *papanggangan*, S.

**5. *Trevesia arborea* MERR.** Contr. Arn. Arb. 8 (1934) 116.

Tree up to 15 m, young parts shortly reddish stellate-tomentose, prickly. *Leaves* palmately lobed, clustered at the ends of the branches; petioles 17–50 cm, shortly rusty tomentose, glabrescent, unarmed, dilated into a sheathing base, ligule bicuspid; blade rotund, 25–40 cm, base cordate, glabrous above, shortly red-pubescent below, coriaceous, usually 9-lobed, sinuses narrow, lobes oblong-elliptic or oblong-oblancoate, acuminate, margin distantly serrate distally. *Inflorescence* a raceme of umbellules, at first reddish pubescent, glabrescent, sometimes with a few spines below; rachis stout (c. 1 cm  $\varnothing$ ), c. 35 cm, bearing branches along its length, and ending in an umbel, bracts oblong-ovate, acuminate 1–2 cm long; primary branches (peduncles) few, spreading, stout, without spines, to c. 15 cm; umbellules of c. 8–13 flowers, pedicels  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, stout (3–4 mm  $\varnothing$ ), reddish tomentose, basal bracts triangular, c. 5 mm long. *Flowers* hermaphrodite. *Calyx* an irregular short



Fig. 37. *Dendropanax borneensis* (PHILIPSON) MERR. *a.* Habit,  $\times \frac{1}{2}$ , *b.* flower,  $\times 5$ , *c.* fruit and ditto in CS,  $\times 5$ , *d.* bifid leaf with area enlarged to  $\times 100$  to show glands (*a-b* NOOTEBOOM 2258, *c* CLEMENS 51039, *d* CLEMENS 28927). Drawn by P. PRENDERGAST.



rim. Corolla hemispherical in bud, c. 6 mm high, 12 mm diam., densely rusty pubescent outside, falling as a calyptra. Stamens c. 13, filaments stout, 4 mm, anthers ovate, c. 4 mm long. Ovary broadly

hemispherical, shortly furfuraceous, 14-celled. Fruit unknown.

Distr. *Malesia*: N. Sumatra (Atjeh).

Ecol. Primary, evergreen forest, 1100 m.

### 15. DENDROPANAX

DECNE & PLANCH. Rev. Hort. IV, 3 (1854) 107; BTH. in B. & H. Gen. Pl. 1 (1865) 943; CLARKE, Fl. Br. Ind. 2 (1879) 733; MERR. Brittonia 4 (1941) 129; HUI-LIN LI, Sargentia 2 (1942) 38; PHILIPSON, Bull. Br. Mus. Nat. Hist. Bot. 1 (1951) 18; HUTCH. Gen. Fl. Pl. 2 (1967) 71; STONE, Gard. Bull. Sing. 30 (1977) 148. — *Gilibertia* RUIZ & PAV. Prod. Fl. Peruv. (1794) 50, *non* J. F. GMEL. 1791; BTH. in B. & H. Gen. Pl. 1 (1865) 944; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 40 & Nachtr. 2 (1900) 254; PHILIPSON, J. Bot. 78 (1940) 116. — *Textoria* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 12. — **Fig. 37.**

Unarmed, usually glabrous small trees, or erect or subscandent shrubs. *Leaves* simple, entire, or sometimes palmately 3–5-lobed, often with pellucid glands, without articulation between blade and petiole; stipular sheath inconspicuous. *Umbels* solitary or compound, or on racemously arranged branches or paniculate; pedicels not articulated below the ovary. *Flowers* sexually dimorphic. *Calyx* on entire rim or 5-dentate. Petals 5, valvate. Stamens 5–8, extrorse. Ovary inferior, 4–8-celled; styles united throughout all or part of their length, or free. Disk fleshy, conical. *Fruit* globose or ellipsoid, usually strongly ribbed when dry; exocarp fleshy; endocarp cartilaginous. Endosperm smooth or rarely weakly ruminate.

Distr. About 30 *spp.* in tropical America and eastern Asia south to *Malesia* (3 *spp.*): N. Sumatra, Malay Peninsula, Borneo. Fig. 38.

Ecol. Rain-forest in lowland and montane regions, 300–3100 m.

Note. Distinguished from *Hedera* by the normally erect habit and the smooth (or only weakly ruminate) endosperm.

#### KEY TO THE SPECIES

- |   |                          |
|---|--------------------------|
| 1. Leaves without pellucid gland-dots . . . . . | 1. <i>D. lancifolius</i> |
| 2. Inflorescence a compound umbel . . . . .     | 2. <i>D. maingayi</i>    |
| 1. Leaves with pellucid gland-dots . . . . .    | 3. <i>D. borneensis</i>  |

1. *Dendropanax lancifolius* (RIDL.) RIDL. Fl. Mal. Pen. 1 (1922) 884; STONE, Gard. Bull. Sing. 30 (1977) 148, f. 6 C. — *Arthrophyllum lancifolium* RIDL. J. Str. Br. R. As. Soc. n. 75 (1917) 38.

Tree to c. 14 m. *Leaves* dispersed along the shoots; petiole c. 5 cm, slightly dilated at the base and with an obscure ligular rim; blade to c. 15 by 3<sup>3</sup>/<sub>4</sub> cm, chartaceous, lanceolate, base narrowly cuneate, apex gradually tapered to an acute point, margin entire but undulate, midrib well defined, secondary and tertiary veins delicate. *Umbel* terminal, compound; peduncle c. 2 cm; secondary rays few, 1–2 cm; pedicels 5–10, c. 1–2 cm. *Calyx* a rim with indistinct teeth. Petals triangular, falling as a cap or separating. Ovary 4–5-celled, styles forming an erect column.

Distr. *Malesia*: Malay Peninsula (Perak) and N. Sumatra (Toba Lands).

Ecol. Montane rain-forest, c. 300–1500 m.

Vern. Sumatra: *modang simarla siak*, Batak lang.

2. *Dendropanax maingayi* KING, J. As. Soc. Beng. 67, ii (1898) 48; RIDL. Fl. Mal. Pen. 1 (1922) 884; STONE, Gard. Bull. Sing. 30 (1977) 48, f. 6 B. — *D. parviflorus* [*non* (CHAMP.) BTH.] CLARKE, Fl. Br. Ind. 2 (1879) 733. — *Gilibertia maingayi* PHILIPSON, J. Bot. 78 (1940) 117.

Slender shrub to c. 1<sup>1</sup>/<sub>2</sub> m, with few branches. Buds enclosed in small cataphylls. *Leaves* dispersed along the shoots; petiole 1<sup>1</sup>/<sub>2</sub>–5 cm, channelled above, slightly dilated at the base and with

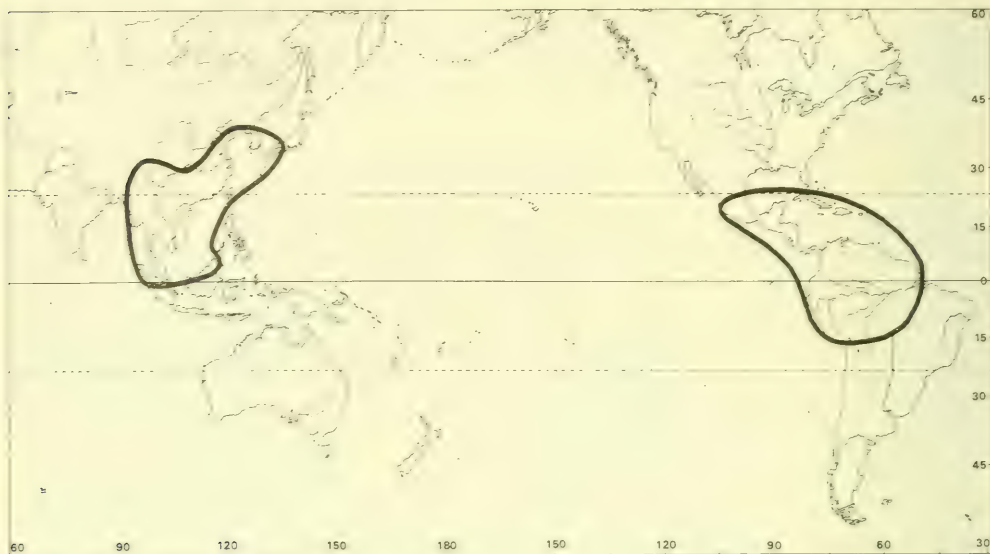


Fig. 38. Range of *Dendropanax* DECNE & PLANCH.

a small to obscure ligule within the petiole; blade 5–15 by 2–5<sup>3</sup>/<sub>4</sub> cm, thinly coriaceous to membranous, ovate, elliptic, oblong or lanceolate, base rounded to narrowly cuneate, apex acute, margin entire, often undulate, midrib prominent, sometimes with three distinct principal veins. *Umbel* terminal, simple, peduncle c. 1–2 cm; pedicels 1–2 cm, slightly elongating in fruit, bracts caducous. *Flowers* sexually dimorphic, males predominate in lateral umbellules. *Calyx* margin minute. Petals triangular, c. 2<sup>1</sup>/<sub>2</sub> mm long. Stamens 5. Ovary 5–6-celled, reduced in male flowers, disk fleshy, conical; styles 5–6, at first erect, but the free upper half spreading in fruit. *Fruit* globose or ellipsoid, succulent, 5–6-ribbed when dry, c. 10 by 8 mm, crowned by the persistent spreading styles.

Distr. *Malesia*: Malay Peninsula (from Kedah southwards).

Ecol. Montane rain-forest, 1000–2000 m.

Note. Very like the next species in the general appearance of leaf and inflorescence. However, all specimens from the Malay Peninsula lack pellucid glands in the lamina of the leaf, whereas these are present in all specimens from Borneo.

**3. *Dendropanax borneensis* (PHILIPSON) MERR.** Brittonia 4 (1941) 132. — *Gilibertia borneensis* PHILIPSON, J. Bot. 78 (1940) 116, fig. — Fig. 37.

Slender shrub or small tree, with few or no branches, occasionally prostrate or subscandent, sometimes reaching 5–6 m. Buds enclosed in few broadly ovate cataphylls. *Leaves* dispersed along

the shoots; petiole 4–10 cm, channelled above, slightly dilated at base and with a small to obscure ligule within the petiole; blade 7–15 by 3–7 cm, coriaceous, with pellucid glands, usually ovate, elliptic or oblong, occasionally irregularly lobed, base rounded to broadly cuneate, apex acute, margin entire, often undulate, midrib and lateral veins prominent, frequently with 3 distinct principal veins. *Umbel* terminal, simple, or occasionally compound, single or two borne side by side, with c. 20 flowers; peduncle and secondary rays (if present) usually rather short (1<sup>1</sup>/<sub>2</sub>–3<sup>1</sup>/<sub>2</sub> cm), but occasionally much longer (to 13 cm); pedicels c. 1<sup>1</sup>/<sub>4</sub>–1<sup>1</sup>/<sub>2</sub> cm (occasionally to 3 cm), elongating slightly in fruit, bracts ovate caducous. *Flowers* sexually dimorphic, males predominate in lateral umbellules. *Calyx* margin minute. Petals triangular, c. 2<sup>1</sup>/<sub>2</sub> mm long. Stamens 5. Ovary 4–6-celled, reduced in male flowers; disk fleshy, conical with 4–6 styles, at first erect, but the free upper half spreading in fruit. *Fruit* globose or ellipsoid, succulent, 4–6-ribbed when dry, 5–10 by 6–12 mm, crowned by the persistent spreading styles.

Distr. *Malesia*: N. Sumatra (Mts Goh Lembuh and Pinto) and northern Borneo (Sabah: Mt Kinabalu; Brunei: Pagon Ridge; Sarawak: Mt Murut and Kalabit Highlands).

Ecol. Local in montane, mossy forest, and alpine thickets, 1700–3100 m.

Vern. Borneo: *merit*, Kalabit Highlands.

Notes. Flower greenish or cream, fruit black.

This species exhibits considerable variation in size and shape of leaf, inflorescence and fruit, and



also in venation pattern, but these variations are not correlated with geographical distribution. Specimens from the two Sumatran localities have small fruits and leaves, but similar specimens occur

in Borneo. The presence of pellucid glands between the reticulations of the veins of the lamina distinguishes this species from the other two species in the area.

## 16. ACANTHOPANAX

(DECNE & PLANCH.) H. WITTE, Ann. Hort. Bot. 4 (1861) 89; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 10; BTH. in B. & H. Gen. Pl. 1 (1865) 938; SEEM. J. Bot. 5 (1867) 238; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 49; MERR. Philip. J. Sc. 1 (1906) Suppl. 217; HUTCH. Gen. Fl. Pl. 2 (1967) 69. — *Panax* subg. *Acanthopanax* DECNE & PLANCH. Rev. Hort. IV, 3 (1854) 105. — **Fig. 39.**

Small trees or scandent shrubs, prickly or unarmed. *Leaves* digitately compound, stipules absent, glabrous or with bristles. *Inflorescence* terminal, with umbels either solitary or more usually umbellately or racemously arranged; pedicels not articulated below the flower. *Flowers* hermaphrodite or sexually dimorphic. *Calyx* margin minutely dentate. Petals 4 or 5, valvate. *Stamens* as many as the petals, anthers dorsifixed, introrse. Ovary 2–4(–5)-celled; disk fleshy; styles 2, connate to about the middle. *Fruit* a subglobose drupe, crowned by the persistent bifid style, 2–4(–5)-seeded; exocarp fleshy, endocarp chartaceous or cartilaginous. Endosperm smooth or undulate.

Distr. About 30 spp. in eastern Asia and the Himalayan region, south to *Malesia* (2 spp.): Malay Peninsula, N. Sumatra (Gajo Lands), Philippines (N. Luzon).

Ecol. Usually in montane forest or in secondary growth.

Note. A sterile specimen from Gunong Iran, Cameron Highlands (SYMINGTON CF 36300) in the Kepong Herbarium, probably represents an undescribed species.

### KEY TO THE SPECIES

- |   |                          |
|---|--------------------------|
| 1. Twigs with prickles. Leaf margins without bristles . . . . . | 1. <i>A. trifoliatum</i> |
| 1. Twigs without prickles. Leaf margins with bristles . . . . . | 2. <i>A. malayanum</i>   |

1. *Acanthopanax trifoliatum* (L.) MERR. Philip. J. Sc. 1 (1906) Suppl. 217. — *Zanthoxylum trifoliatum* LINNÉ, Sp. Pl. (1753) 270. — *Panax aculeatum* AIT. Hort. Kew. ed. 1, 3 (1789) 448. — *A. aculeatum* H. WITTE, Ann. Hort. Bot. 4 (1861) 89, *nom. illeg.*; SEEM. J. Bot. 5 (1867) 238; HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 50.

Scandent shrub, c. 2–8 m, with broadly based recurved prickles sparsely disposed on the branches, usually below the nodes; buds with small brown cataphylls. *Leaves* disposed along the branchlets; petiole up to c. 5 cm, flattened above, with a slightly dilated base, glabrous, usually with a few prickles; leaflets (1–)3(–5); petiolules up to 8 mm, articulated with the petiole, channelled above; blade up to  $3\frac{1}{2}$  by  $2\frac{1}{4}$  cm, broadly ovate to subrotund, apex acute, base cuneate, margins serrate, chartaceous, glabrous, lateral veins conspicuous on both surfaces, pinnate, reticulation inconspicuous. *Inflorescence* terminating the main or lateral branches, a sessile compound umbel; primary

rays c. 4–5, or rarely solitary, slender or the central ray stronger (the laterals sometimes apparently male), with minute furfuraceous bracts at their bases, occasionally with a few prickles, glabrous, c. 3–6 cm long; secondary rays (pedicels) numerous, slender, c.  $1\frac{1}{3}$  cm. *Calyx* a rim with 5 minute teeth. Petals 5, ligulate, c. 2 mm long. Stamens 5, filaments c. 2 mm. Ovary turbinate, c.  $1\frac{1}{2}$  mm high, 2-celled; styles 2, connate to about the middle. *Fruit* a spheroidal drupe, c. 5 mm  $\varnothing$  when dry, crowned by the persistent bifid style; endocarp chartaceous. Endosperm surface slightly undulate.

Distr. From the Himalayas through S. China to Japan and Formosa; in *Malesia*: Philippines (N. Luzon: Benguet; Bontoc).

Ecol. In montane forest and thickets, 1100–1400 m.

2. *Acanthopanax malayanum* M. R. HENDERSON, Gard. Bull. S. S. 7 (1933) 105, pl. 22. — **Fig. 39.**

Unarmed tree to 17 m, trunk to 1 m  $\varnothing$ ; branch-

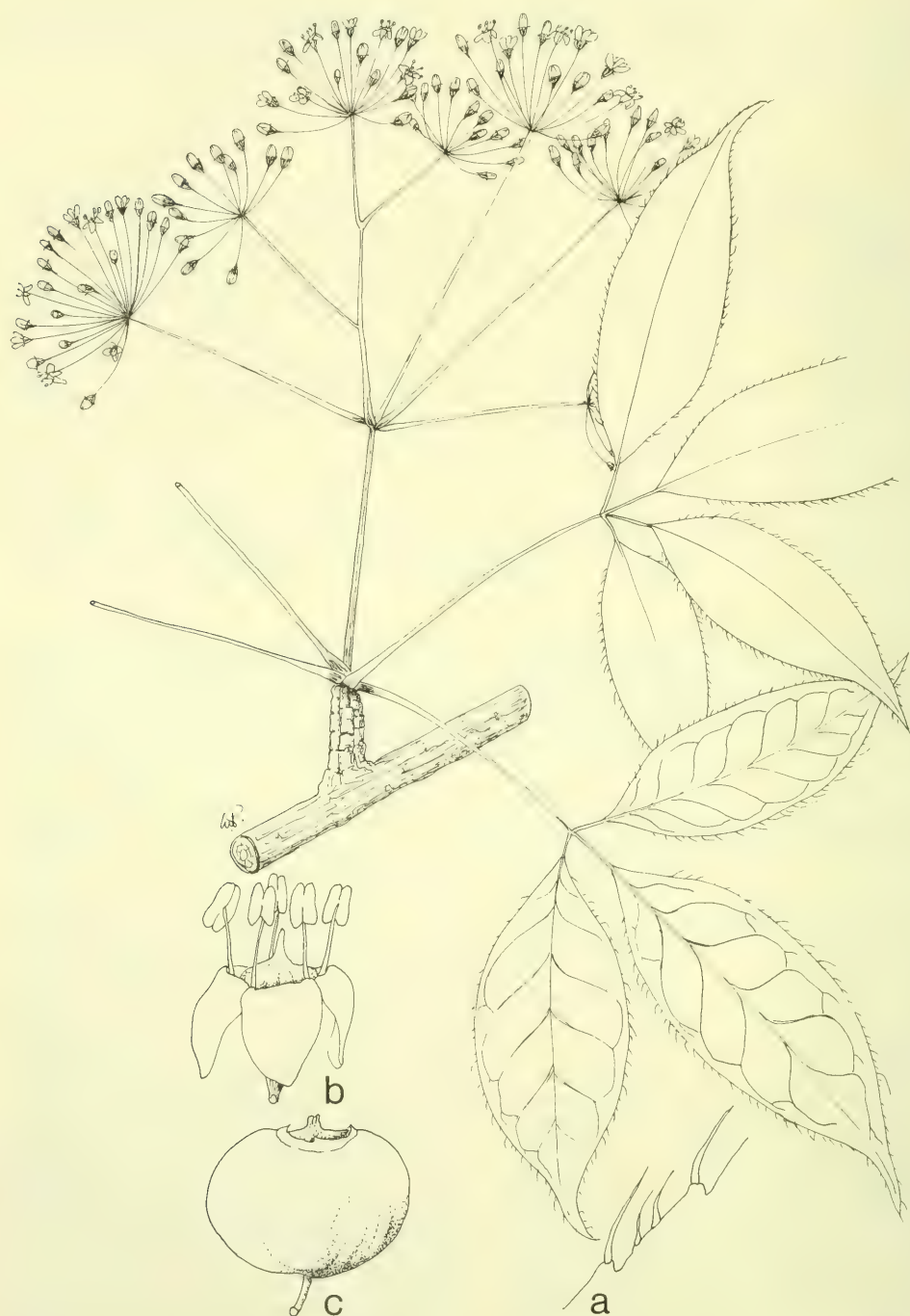


Fig. 39. *Acanthopanax malayanus* HENDERSON. a. Habit,  $\times \frac{1}{2}$ , b. flower,  $\times 7$ , c. fruit,  $\times 4$  (a, b DE WILDE c.s. 16725, c DE WILDE c.s. 15925). Drawn by W. R. PHILIPSON.



lets rather stout (c. 5 mm  $\varnothing$ ); bark greyish brown, glabrous, smooth; buds with small brown cataphylls. *Leaves* crowded at the ends of the branchlets; petiole terete, striate, glabrous, with a slightly dilated base, up to 12½ cm; leaflets 3–5; petiolules up to 7 mm, articulated with the petiole, channelled above; blade up to 17 by 5½ cm, ovate-lanceolate to narrowly elliptic, apex acute, base cuneate or one side truncate, chartaceous, the principal veins pinnately arranged and conspicuous, the minor veins forming a dense reticulation, margin with numerous spinulose teeth. *Inflorescence* a terminal, sessile, compound umbel, often on short lateral shoots, apparently dioecious; primary rays c. 3–7, slender, terete, glabrous, striate, c. 4–8 cm; secondary rays (pedicels) of male flowers numerous, slender, 1½–2 cm, of female flowers stouter. *Calyx* a rim with 4–5 minute teeth. Petals 4–5, ligulate, c. 2½ by 1½ mm long. Stamens 4–5, filaments c. 2¾ mm long. Ovary turbinate, 3–4-celled; styles 2, at first connate, but becoming free to about the middle. *Fruit* an oblate spheroidal

drupe, c. 10 by 8 mm when dry, with a small stylopodium bearing a persistent bifid style; endocarp cartilaginous. Endosperm surface strongly undulate.

*Distr. Malesia:* Malay Peninsula (Pahang; Cameron Highlands), N. Sumatra (Gajo Lands).

*Ecol.* Montane rain-forest and mossy forest, 1400–2600 m.

*Vern. Berlaki*, Sakai lang.

*Notes.* The interpretation of this species as having sexually dimorphic inflorescences cannot be proved with the available material. This appears to consist of twigs bearing either inflorescences of male flowers, or infructescences. Appearances suggest that the putative male flowers have rudimentary ovaries. There is no evidence whether the fruiting flowers had produced pollen.

The tree is said to be conspicuous when flowering by reason of its delicate feathery foliage, which is pale green with a reddish tinge, the petioles and inflorescence also being reddish.

#### Excluded

*Meryta colorata* F. M. BAILEY, Queensl. Agric. J. 3 (1898) 283; HARMS, Bot. Jahrb. 56 (1920) 384.

The type specimen of this species cannot be located, but the original description does not seem to relate to a member of the *Araliaceae*, and certainly not to a *Meryta*.

*Panax ? anisum* DC. Prod. 4 (1830) 254. — *Anisum moluccanum* RUMPH. Herb. Amb. 2: 131, t. 42. — *Nothopanax ? anisum* MIQ. Fl. Ind. Bat. 1, 1 (1856) 766; SEEM. Fl. Vit. (1866) 114. — *Polyscias anisum* HARMS in E. & P. Nat. Pfl. Fam. 3, 8 (1894) 45.

According to MERRILL (Int. Rumph. 1917, 289) these names are all based on the Rumphian description and plate and must refer to some species of *Fagara*, possibly *F. avicennae* LAMK = *Zanthoxylum avicennae* (LAMK) DC. (*Rutaceae*).





## 28. CAREX

LINNÉ, Gen. Pl. ed. 5 (1754) 420; Sp. Pl. (1753) 972; ENDL. Gen. (1836) 110; KUNTH, En. 2 (1837) 368; STEUD. Syn. 2 (1855) 182; MIQ. Fl. Ind. Bat. 3 (1856) 346; BOOTT, Illustr. Genus Carex I-IV (1858-67); BOECK. Linnaea 39 (1875) 14; *ibid.* 40 (1876) 327; *ibid.* 41 (1877) 145; B. & H. Gen. Pl. 3 (1883) 1073; PAX in E. & P. Nat. Pfl. Fam. 2, 2 (1887) 122; CLARKE, Fl. Br. Ind. 6 (1894) 699; J. Linn. Soc. Bot. 37 (1904) 1; Philip. J. Sc. 2 (1907) Bot. 107; KÜK. Pfl. R. Heft 38 (1909) 67; Philip. J. Sc. 6 (1911) Bot. 57; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 232; NELMES, Kew Bull. (1946) 5; Reinwardtia 1 (1951) 221; *ibid.* 2 (1954) 373; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 17; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 149; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 487. — Fig. 118-135.

Perennial herbs with tufted or creeping rhizome, monoecious, rarely dioecious. *Stems* arising centrally or laterally, erect or obliquely erect, mostly triquetrous or trigonous, rarely subterete, solid or sometimes hollow, often clothed at the base by persistent leaf-sheaths or their fibrous remains. *Leaves* tristichous, usually narrowly linear, sheathing at the base, with a ligule at the junction of blade and sheath, rarely lanceolate or elliptic with a more or less distinct petiole and eligulate, mostly basal and subbasal, 0-several higher on the stem, the lower ones often reduced to bladeless sheaths; sheaths of the stem-leaves and bracts closed. *Inflorescence* paniculiform, racemiform or spiciform, more rarely reduced to a single spikelet. *Spikelets* 1-very numerous, terete, sessile or peduncled, few- to many-flowered, wholly male, wholly female, or bisexual (androgynous when male flowers above, gynaeandrous when female flowers above). Bracts foliaceous or glume-like, often sheathing, sometimes wanting. Base of the branches of the inflorescence usually with a utriculiform or ocreiform bracteole (*cladophyllum*) surrounding it. *Flowers* unisexual, naked, solitary in the axils of the spirally arranged glumes; male flowers consisting of 3 free or rarely more or less connate stamens; anthers linear; female flowers consisting of a single pistil enclosed in a bottle-shaped prophyll (*utricle*, *perigynium*). *Style* either continuous with the ovary and persistent, or articulated with it and deciduous, straight or flexuous, often incrassate at the base; stigmas 2 or 3, protruding through the small terminal orifice of the utricle. Vestigial *rachilla* (see *Uncinia*) rarely present. *Utricles* membranous, chartaceous, or coriaceous, bicarinate, sometimes winged, sessile or stipitate, beakless to strongly beaked, nerveless, nerved, or ribbed, glabrous, or pubescent or hispid, papillose or punctulate or smooth, sometimes spongy at the base; beak truncate, obliquely cleft, bidentate, or bifurcate at the top. *Nut* trigonous (when stigmas 3), or lenticular (plano-convex or biconvex; when stigmas 2), enclosed within the utricle.

*Distr.* A large genus with 600 to 1000 *spp.*, the majority of them outside the tropics. However, the most primitive section, *Vigneastra* with a compound, paniculate inflorescence and androgynous spikelets, occurs mainly in the tropics of the Old World, from sea-level up to 3000 m. This section is represented in Malesia with 11 *spp.*, and is there by far the largest section.

*Subg.* *Carex* is, besides with the 11 *spp.* of *sect. Vigneastra*, represented in Malesia by 25 sections and 49 *spp.*, *subg. Vigneia* with 6 sections and 6 *spp.*

(1) Continued from volume 7, part 3 (1974) p. 753.

Of the 66 *spp.* in all, 12 *spp.* are endemic and mostly confined to one island. Of the other 54 *spp.* the majority occur also in the northern hemisphere, either widely or only in SE. and/or E. Asia. Of these, 25 *spp.* extend without noticeable disjunctions into Malesia, either to its western part or further eastward. Another 4 of the E. Asian *spp.* occur in Formosa and in Malesia only in the Philippines (mostly only in Luzon), viz 12. *C. satzumensis*, 30. *C. rhyrachchaenium*, 32. *C. dolichostachya*, and 33. *C. formosensis*.

Among the Asian *spp.* 4 show a distinct disjunction between SE. Asia and Java, viz 11. *C. vesiculosa*, 14. *C. helferi*, 63. *C. nubigena*, and 58. *C. longipes* (which is also once found in Celebes and once in New Guinea); all are mountain species.

A similar disjunction is found in the lowland species 10. *C. stramentitia* and 38. *C. tricephala*; this disjunction is understandable as both are bound to a distinct seasonal climate which shows a similar pattern (see VAN STEENIS, Reinwardtia 5, 1961, 420-429).

Still larger disjunctions are shown by 5 E. Asian *spp.* which are in Malesia almost only found in New Guinea, Formosa being mostly the nearest station, viz 46. *C. brachyathera*, 47. *C. finitima* (also in N. Sumatra), 48. *C. michauxiana*, 56. *C. bilateralis*, and 61. *C. duriuscula*; all are mountain plants.

Not a few *Carex spp.* occur in both the northern and southern hemisphere (Australia, often Tasmania and New Zealand) and are also found in the intervening tropical zone in Malesia. There are 11 of such species in all. Among these the following 7 are found in more than one island, viz 6. *C. indica*, 31. *C. breviculmis*, 39. *C. maculata*, 40. *C. capillacea*, 57. *C. brunnea*, 5. *C. horsfieldii*, and 64. *C. echinata*, although the latter two are very rare. Four others are also transtropical but are in Malesia only found in New Guinea, and thus show almost the same disjunction between Formosa and New Guinea as mentioned above; these are 43. *C. brownii*, 49. *C. pseudocyperus*, 55. *C. gaudichaudiana*, and 66. *C. curta*. They occur in Malesia only in bogs and marshes on (high) mountains.

The southern hemisphere has contributed very little to the Malesian *Carices*, as there is only one southern species from Australia, New Zealand, and New Caledonia, viz 62. *C. appressa*, which is found in Malesia, and then again only in New Guinea at very high altitude.

Summarizing, one cannot withdraw oneself from concluding that only the presence of mountain bogs, marshes and grasslands gives the opportunity for the maintenance of *Carex* in the Malesian tropics. This would explain why the big mountainous island of New Guinea — where this habitat is most abundantly represented, much more than in any other island — is so rich in species. It is then also understandable that this is the place where relict areas could maintain their last stand in the tropical mountains of Malesia.

Ecol. Most species prefer moist or wet localities, some are found in rain-forest, others in open habitats like in mountain marshes, grassland, heaths, etc. Only 22 *spp.* grow below 1000 m, 8 of them belonging to *sect. Vigneastra*, 13 are found below 500 m, 4 of them of *sect. Vigneastra*; 14 *spp.* occur exclusively above 2000 m. 57. *C. brunnea*, which is found from 80 m up to 3400 m, has the largest altitudinal range.

The majority of the *Carex spp.* is growing on more or less acid soils. Three species of the lowland tropics occupy a different habitat, and are bound to a seasonal climate, viz 10. *C. stramentitia*, 38. *C. tricephala*, and 37. *C. speciosa*. The first two occur only in Java or Madura I., amongst others with the teak-forest; the third of these drought species occurs also in some local dry spots in E. Sumatra and SE. Borneo, and is obviously adapted to a slightly less severe dry season.

Of the three mentioned species, *C. tricephala* and *C. speciosa* are confined to limestone, like one other species, 35. *C. malaccensis*, an endemic of N. Malaya (the Langkawi Is.).

One species, 59. *C. teinogyna*, seems in Malesia to be confined to banks of swift streams and occupies a rheophytic habitat.

Notes. The distinction of the sections is not always unanimously agreed on, and several species were put into different sections by different authors. Some sections are closely allied, the only difference being sometimes 2 versus 3 carpels. As this has great influence on the shape of the nut, it often is considered a very important character. In my opinion the difference is due to a minor genetic difference, and is taxonomically not very important. Besides, in some collections 2-carpelled and 3-carpelled fruits are found in the same inflorescence, e.g. in species of *sect.*



*Graciles*, which has normally 2 carpels, and of *sect. Oligostachyae* (*Decorae*) which has normally 3 carpels (NOOT.).

Acknowledgement. The manuscript of *Carex* was for the greater part elaborated by Dr. J. H. KERN before he died in 1974. The obstacle for finishing it in time was his worry about the status *cf.* evaluation of a number of names in *sect. Vigneastra*, which also prohibited the finishing of the practical key to the species. Dr. H. P. NOOTEBOOM has done this evaluation and he made the final draft of the key, for which he is responsible. He is also responsible for the treatment offered here for several species, *viz* 3. *C. cruciata*, 18. *C. perakensis*, 19. *C. turrita*, 20. *C. verticillata*, and 31. *C. breviculmis*, and for some critical notes which have been marked "NOOT." between brackets. The division in subgenera and sections is largely from Dr. KERN. The revision of *Uncinia* is entirely by Dr. NOOTEBOOM. (Ed.)

Explanation of some terms. The term 'stems' refers to the flower-bearing stems, except when stated otherwise, whereas 'inflorescence' means the entire flower-bearing stem including all the spikelets. The terms used for the inflorescence ('panicle', 'raceme') indicate the disposition of the spikelets, not of the individual flowers. 'Stems central' means that the leaves are arranged around the flower-bearing stem (usually towards the base). 'Stems lateral' means that the leaves are placed on a vegetative shoot, and that the flower-bearing stems arise separately from the rhizome and bear few short-bladed leaves. The flowering stems can also be situated in the axils of the leaves. This situation is sometimes difficult to distinguish from 'stems central', because the leaves are often crowded in a basal rosette.

The bracts are inserted on the stem and they are sheathing or not; they bear in their axils a spikelet or a partial inflorescence, the peduncles of which are often basally surrounded by a cladophyllum; this is a bracteole which is utriculiform or ocreiform. If the cladophyllum is ocreiform, it usually is hidden entirely in the sheath of the bract. Each flower is solitary in the axil of a glume; several flowers together form a spikelet which can be ♂, ♀, or bisexual; in the latter case the ♂ flowers are usually placed only at the base or at the apex of a spikelet. Gynaecandrous spikelets have ♀ flowers above, ♂ below, androgynous spikelets have ♂ flowers above and ♀ below.

The figures 118–123, depicting utricles and nuts of nearly all the species, and some glumes (fig. 132), are given to facilitate use of the keys.

#### KEY TO SUBGENERA AND SECTIONS

##### as represented in Malesia

1. Stigmas 3 and nut trigonous, or, when stigmas 2 and nut lenticular (plano-convex or biconvex) some or all of the spikelets peduncled or terminal spikelet ♂. Spikelets either dissimilar in appearance (the terminal one ♂ and some or all the lateral ones ♀), or similar in appearance (all bisexual). Base of the peduncles of the lateral spikelets or of the branches of the inflorescence surrounded by a utriculiform or ocreiform bracteole (*cladophyllum*); inflorescence sometimes reduced to a single terminal spikelet  
I. SUBG. CAREX
2. Stigmas 3; nut trigonous.
3. Inflorescence consisting of more than one spikelet.
  4. Lateral spikelets arising from a gaping, utriculiform, fertile (*i.e.* nut-bearing) cladophyllum. Spikelets androgynous, up to 15 mm long. Bracts not sheathing. Stems 3–20 cm tall. *Sp.* 12  
2. *Sect. Japonicae*
  4. Lateral spikelets arising from a sterile cladophyllum, or sessile without cladophyllum.
  5. Stems scapiform, surrounded at the base by spadiceous sheaths in place of leaves. Leaves wide, conduplicate-petioled below. Secondary panicles contracted, very dense. Utricles with very long linear beak and very oblique mouth. *Sp.* 14 . . . . . 4. *Sect. Mapaniifoliae*
  5. Otherwise.
    6. Spikelets peduncled, in fascicles in the axils of at least some of the sheathing bracts, all androgynous or some wholly ♂ or ♀. Utricles long-beaked. *Spp.* 17–20 . . . . . 6. *Sect. Oligostachyae*
    6. The peduncled or sessile spikelets or secondary panicles single or binate in the axils of the bracts.
    7. Spikelets similar in appearance, androgynous (upper flowers ♂, lower ones ♀).
    8. Lower bracts not or only shortly (some millimeters) sheathing.
    9. Apex of nut truncate,  $\frac{1}{2}$ – $\frac{3}{4}$  mm  $\varnothing$ , hollowed out. Style centred in the apical hollow of the nut. Utricles lageniform or rhomboid-lageniform. *Spp.* 27–30. . . 10. *Sect. Lageniformes*

9. Apex of nut not truncate. Style base pyramidally thickened, often broader than apex of nut. *Spp.* 35–38 . . . . . **12. Sect. Radicales**
8. Lower bracts long sheathing.
10. Flowering stems arising from the axils of the leaves which are crowded on a short stem and much longer than the flowering stems. Style flexuous. Nut with irregularly excavated sides, seated on a spongy, disk-like stipe. *Sp.* 26 . . . . . **9. Sect. Cryptostachyae**
10. Flowering stems arising either from the centre of the leaves, or from lateral shoots bearing a few short-bladed leaves.
11. Spikelets small, up to 15(–20) mm long.
12. Stems central. Spikelets numerous, ovoid or oblong-ovoid, arranged in often diffuse, compound panicles. Bracts long. *Spp.* 1–11 . . . . . **1. Sect. Vigneastrae**
12. Stems lateral. Spikelets few, globose-ovoid, in a simple panicle. Bracts shorter than 8 cm, the sheaths not included. *Sp.* 21 . . . . . **7. Sect. Surculosae**
11. Spikelets longer.
13. Utricles densely many-nerved. Spikelets 1–8(–14).
14. Utricles ellipsoid, short-beaked, more or less ciliate on the margins, spongy-thickened at the base. Spikelets 1–3(–4). *Spp.* 35–38 . . . . . **12. Sect. Radicales**
14. Utricles narrowly ellipsoid, long-beaked, more or less hispidulous on the faces, not spongy-thickened at the base. Spikelets 2–8(–14). *Spp.* 17–20 . . . . . **6. Sect. Oligostachyae**
13. Utricles distinctly but not densely nerved. Leaves with reddish sheaths splitting into fibres. Spikelets 6–numerous. *Spp.* 15–16 . . . . . **5. Sect. Polystachyae**
7. Spikelets dissimilar in appearance, unisexual (or rarely gynaeandrous), the terminal one or some upper ones ♂, the remainder ♀ (occasionally the ♀ spikelets may have a few ♂ flowers, and the ♂ spikelets a few ♀ flowers). Or most of the spikelets ♀, shortly cylindrical, the ♂ spikelets lateral, 1–5 just below some of the terminal ♀ spikelets.
15. Leaves not crowded in a basal rosette but inserted all over the stem, the upper ones merging into leafy bracts, the lower ones gradually decreasing in length and merging into bladeless sheaths.
16. Inflorescence a compound panicle consisting of 5–8 secondary panicles each containing numerous ♀ spikelets and 1–5 ♂ spikelets. Spikelets small, 4–8 mm long. Utricles glabrous, with short,  $\frac{1}{4}$  mm long beak. Leaves sparsely hairy beneath. *Sp.* 13 . . . . . **3. Sect. Hypolytroides**
16. Inflorescence simple, racemose, consisting of 4–9 spikelets; terminal spikelet ♂ (sometimes a second, smaller one added), remaining spikelets ♀,  $1\frac{1}{2}$ –4 cm long. Utricles densely hispid, with distinct, c. 1 mm long beak. Leaves glabrous. *Sp.* 50. . . . . **21. Sect. Occlusae**
15. Leaves crowded at the base of the stem, often also some higher on the stem.
17. Nut excavated in the middle, the apex abruptly narrowed into a conspicuous, hastiform, i.e. cylindric,  $\frac{1}{2}$ – $\frac{1}{3}$  mm long beak expanding into the annulate apex. *Spp.* 22–25 . . . . . **8. Sect. Rhomboidales**
17. Nut without hastiform beak.
18. Apex of nut truncate,  $\frac{3}{4}$ –1 mm wide, hollowed out. Style centred in the apical hollow of the nut. Utricles lageniform or rhomboid-lageniform. *Spp.* 27–30 . . . . . **10. Sect. Lageniformes**
18. Apex of nut not truncate, at most  $\frac{1}{2}$  mm wide.
19. Nut mitrate, i.e. contracted at the apex and then expanded into a discoid annulus. Utricles ovoid or ellipsoid. *Spp.* 31–34 . . . . . **11. Sect. Mitratae**
19. Nut not mitrate.
20. Utricles densely papillose, erostrate or but shortly beaked. *Sp.* 39 . . . . . **13. Sect. Trachychlaenae**
20. Utricles not papillose, distinctly beaked.
21. ♀ Spikelets broadly ovoid or subglobose, with few narrowly lanceolate, c. 1 cm or more long utricles. Bracts sheathing. Rhizome short. *Sp.* 48 . . . . . **19. Sect. Folliculatae**
21. ♀ Spikelets not broadly ovoid-subglobose. Utricles smaller.
22. Spikelets linear-cylindric, loosely flowered. Utricles nerveless (except for 2 submarginal nerves) or obscurely nerved, with long beak and oblique mouth. Bracts sheathing.
23. Utricles hispidulous, brownish. *Sp.* 46 . . . . . **17. Sect. Ferrugineae**
23. Utricles glabrous, light green. *Sp.* 47 . . . . . **18. Sect. Sylvaticae**
22. Spikelets oblong or cylindric. Utricles many-nerved.
24. Spikelets short-cylindric, few-flowered. Utricles fusiform-ellipsoid or rhomboid, at least towards the base many-nerved. Flowering stems lateral or central. *Spp.* 22–25 . . . . . **8. Sect. Rhomboidales**
24. Spikelets cylindric, densely many-flowered.



25. Utricles firm, of thick texture, short-beaked. Rhizome emitting strong stolons. Leaves conspicuously septate-nodulose. Spikelets erect. Bracts not or scarcely sheathing. *Sp.* 60 . . . . . 26. *Sect. Paludosae*
25. Utricles membranous, with long beak (except in *C. brownii* ssp. *brownii*).
26. Spikelets erect. Utricles patulous, subinflated, many-nerved, with shortly bidentate beak. Style straight. Rhizome often creeping. *Spp.* 42–45 . . . . . 16. *Sect. Anomalae*
26. Lower spikelets cernuous. Utricles widely patent to reflexed, closely many-ribbed, with bifurcate beak. Style flexuous. Rhizome cespitose. *Sp.* 49 . . . . . 20. *Sect. Pseudocypereae*
3. Inflorescence consisting of a single terminal spikelet.
27. Utricles with whitish pubescent margins or hispidulous, densely and strongly many-nerved, 4–10 mm long. *Spp.* 35–38 . . . . . 12. *Sect. Radicales*
27. Utricles glabrous,  $1\frac{1}{2}$ –5 mm long.
28. Utricles rather large ( $4\frac{1}{2}$ –5 mm long), with slender, linear, bidentate beak. *Sp.* 41 . . . . . 15. *Sect. Rhizopodae*
28. Utricles small ( $1\frac{1}{2}$ –4 mm long), with short, subentire or slightly emarginate beak. *Sp.* 40 . . . . . 14. *Sect. Capitellatae*
2. Stigmas 2; nut lenticular (plano-convex or biconvex).
29. Bracts sheathing. Spikelets often in fascicles. Utricles often hispidulous, membranous, nerved, usually long-beaked. Stigmas often very long. *Spp.* 56–59 . . . . . 25. *Sect. Graciles*
29. Bracts not sheathing (or very shortly).
30. Lateral spikelets sessile or the lowest shortly peduncled, erect. Terminal spikelet ♂. Glumes muticous. *Sp.* 55 . . . . . 24. *Sect. Carex*
30. Spikelets peduncled, cernuous. Glumes often awned.
31. Spikelets 3–8, single at the nodes, cylindric, short peduncled. Terminal spikelet ♂, or (often with exception of basal spikelets) spikelets gynaeandrous. *Spp.* 52–54. . . . . 23. *Sect. Praelongae*
31. Spikelets 6–50, single or binate at the nodes, the lower ones long-peduncled, all androgynous or some ♂, linear-cylindric. *Sp.* 51 . . . . . 22. *Sect. Longispicae*
1. Stigmas 2 and nut lenticular. Spikelets similar in appearance, bisexual, sessile. Cladophylla usually absent . . . . . II. SUBG. VIGNEA
32. Spikelets androgynous (upper flowers ♂, lower ones ♀).
33. Rhizome long-creeping. Spikelets 4–7. Utricles coriaceous, plano-convex, sharp-edged but not winged. *Sp.* 61 . . . . . 27. *Sect. Divisae*
33. Rhizome short, forming dense tufts. Spikelets numerous or very numerous.
34. Utricles coriaceous, with rounded margins. Bracts inconspicuous. *Sp.* 62 . . . . . 28. *Sect. Paniculatae*
34. Utricles membranous, with acute or winged margins. Lower bracts foliaceous. *Sp.* 63 . . . . . 29. *Sect. Multiflorae*
32. Spikelets gynaeandrous (upper flowers ♀, lower ones ♂). Utricles membranous.
35. Utricles with rounded margins, densely whitish-puncticulate, beakless or very shortly beaked. Spikelets ebracteate (bracts glumiform). *Sp.* 66 . . . . . 32. *Sect. Heleonastes*
35. Utricles with acute or winged margins, not puncticulate.
36. Utricles obliquely erect, also when mature. Spikelets more or less distinctly bracteate. *Sp.* 65 . . . . . 31. *Sect. Elongatae*
36. Utricles widely spreading or reflexed when mature. Spikelets not or inconspicuously bracteate (bracts glumiform). *Sp.* 64 . . . . . 30. *Sect. Stellulatae*

## KEY TO THE SPECIES

Only complete specimens with nearly or fully mature utricles are identifiable. As the distribution of sexes is variable, especially in the species with a terminal male spikelet, it is advisable to examine several specimens if possible.

In the measurements of the length of the utricles the beak is included. Unless stated otherwise 'glumes' refers to the glumes subtending the *female* flowers.

1. Inflorescence consisting of a single (androgynous) spikelet terminating the stem. Stigmas 3; nut trigonous.
2. Utricles with whitish pubescent margins, or hispidulous, or winged and scabrid margined, 4–8 mm long. Glumes (many-)nerved. Style pyramidally thickened towards the base, persistent on the nut. Leaves (2–)3–10 mm wide.
3. Spikelets 2–8 cm long. Utricles with whitish pubescent margins . . . . . 37. *C. speciosa*
3. Spikelets 6–12 mm. Utricles hispidulous or glabrous with scabrid margins.

4. Utricles hispidulous in the upper  $\frac{2}{3}$ , 4–6 mm, with conic-cylindric, 1–2 $\frac{1}{2}$  mm long beak.

38. *C. tricephala*

4. Utricles glabrous with scabrid, distinctly winged margins, 6–8 mm, gradually narrowed into the 3 mm long beak . . . . . 36. *C. ramosii*

2. Utricles glabrous, membranous and otherwise different, 2–5 mm long. Glumes 3-nerved in the centre, otherwise nerveless. Style not or but slightly thickened towards the base. Leaves  $\frac{1}{2}$ –3 mm wide.

5. Utricles (1 $\frac{1}{2}$ –)2 $\frac{1}{2}$ –3 $\frac{1}{2}$ (–4) mm long, rather gradually tapering into a very short, subentire or slightly emarginate beak. Leaves  $\frac{1}{2}$ –2 mm wide. Glumes 1 $\frac{1}{2}$ –3 mm long . . . . . 40. *C. capillacea*

5. Utricles 4 $\frac{1}{2}$ –5 mm long, abruptly narrowed into a slender, linear, bidentate, c. 1 $\frac{1}{2}$  mm long beak. Leaves 2–3 mm wide. Glumes 3–4 mm long . . . . . 41. *C. eremostachya*

1. Inflorescence consisting of 2 or more spikelets.

6. Terminal and most of the other spikelets ♀, shortly cylindrical, the ♂ spikelets lateral, 1–5, just below some of the terminal ♀ spikelets. Inflorescence a compound panicle. Leaves all over the stem

13. *C. hypolytroides*

6. Terminal spikelet bisexual or wholly ♂.

7. Terminal spikelet wholly ♂ (exceptionally in some specimens with a few ♀ flowers), or when spikelets in fascicles, 1–2 spikelets of the upper fascicle wholly ♂.

8. Stigmas 3.

9. Leaves inserted all over the stem, the upper ones merging into leafy bracts, the lower ones gradually decreasing in length and merging into bladeless sheaths. Inflorescence simple, racemose, consisting of 4–9 spikelets. Spikelets 1 $\frac{1}{2}$ –4 cm long. Utricles densely hispid, with distinct, c. 1 mm long beak. Leaves glabrous. . . . . 50. *C. maubertiana*

9. Leaves basal and often also some higher on the stem.

10. Nut excavated in the middle, the apex abruptly narrowed into a conspicuous, cylindric,  $\frac{1}{2}$ –1 $\frac{1}{4}$  mm long beak expanding into the annular apex . . . . . 22. *C. anomocarya*

10. Nut different.

11. Apex of nut truncate,  $\frac{3}{4}$ –1 mm wide, hollowed out. Style centred in the apical hollow of the nut. Utricles lageniform or rhomboid-lageniform.

12. Utricles 5–7 mm long. Apex of nut contracted into a cylindric, truncate,  $\frac{2}{3}$ –1 mm long and wide neck.

13. Leaves 5–10 mm wide. Beak of utricles 1 $\frac{1}{2}$ –2 mm long. Stems arising from basal leaf axils . . . . . 28. *C. gracilispica*

13. Leaves 1–3 mm wide. Beak of utricles  $\frac{3}{4}$ –1 mm long. Stems central . . . . . 30. *C. rhynchachaenium*

12. Utricles 3 $\frac{1}{2}$ –4 $\frac{1}{2}$  mm long. Apex of nut hardly or not contracted into a cylindric neck

27. *C. breviscapa*

11. Apex of nut not truncate, at most  $\frac{1}{2}$  mm wide.

14. Utricles densely papillose, subabruptly contracted into a very short, up to  $\frac{1}{2}$  mm long beak . . . . . 39. *C. maculata*

14. Utricles not papillose, nut either mitrate or distinctly beaked.

15. Nut mitrate, *i.e.* contracted at the apex and then expanded into a discoid annulus.

16. Glumes of ♂ spikelets cup-shaped, the margins more than halfway connate in front. Stamens monadelphous (not always so in the lowermost flowers). Utricles many-nerved . . . . . 34. *C. tristachya*

16. Glumes of ♂ spikelets with free margins. Stamens free.

17. Nut rhomboid with deeply concave faces. . . . . 33. *C. formosensis*

17. Nut (long-)jellipsoid to ovoid or obovoid.

18. Leaves 3–10 mm wide. Stems arising from basal leaf-axils. Utricles strongly many-nerved . . . . . 32. *C. dolichostachya*

18. Leaves 1–4(–6) mm wide. Stems central. Utricles nerveless to multinerved.

31. *C. breviculmis*

15. Nut not mitrate.

19. Spikelets in fascicles of 3–20 from the axils of at least one of the bracts.

20. Utricles narrowly ellipsoid, 4–6 $\frac{1}{2}$  mm long, gradually tapering below into a stipe-like,  $\frac{3}{4}$ –1 mm long base, above into a 1–3 mm long beak . . . . . 20. *C. verticillata*

20. Utricles ovoid or ellipsoid, 2 $\frac{1}{3}$ –3 $\frac{1}{2}$  mm long, scarcely stipitate; beak  $\frac{3}{4}$ –1 mm long.

17. *C. celebica*

19. Spikelets solitary (exceptionally binate) from the axils of the bracts, or crowded at the apex of the stem.

21. Utricles (8–)12–13 mm, many-nerved. ♀ Spikelets broadly ovoid to subglobose, 15–25 mm long and wide, with few, divergent, narrowly lanceolate utricles. Bracts long-sheathing

48. *C. michauxiana*



21. Utricles at most  $7\frac{1}{2}$  mm long. Other characters not so combined.
22. Broader leaves 1–2 cm wide. Spikelets  $5\frac{1}{2}$ –16 cm long. Glumes vinaceous to dark red with a green, central stripe. Stoloniferous . . . . . **45. *C. olivacea***
22. Broader leaves at most 10 mm wide. Spikelets usually much shorter.
23. Stems lateral. Lateral spikelets 6–12 by 4–7 mm, ♀ or androgynous. Utricles at least below many-nerved, 5–7 mm long. Glumes  $2\frac{1}{2}$ –4 mm. Nut 3–4 mm.
24. Leaves 3–7 mm wide. Glumes  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm, with a  $1\frac{1}{2}$ –6 mm long awn. Lateral spikelets ♀ . . . . . **24. *C. lateralis***
24. Leaves  $1\frac{1}{2}$ –3 mm wide. Glumes c. 4 mm long, muticous or mucronulate. Lateral spikelets androgynous . . . . . **25. *C. loheri***
23. Stems central. Lateral spikelets more than 10 mm long, ♀ or rarely androgynous, when shorter than 12 mm nut  $2\frac{1}{2}$ –3 mm.
25. Utricles  $5$ – $7\frac{1}{2}$  mm long; nut at least  $2\frac{1}{4}$  mm long.
26. Glumes  $2$ – $2\frac{1}{2}$  mm, with an antrorsely scabrous, 2–4 mm long awn. Utricles with deeply furcate  $1\frac{1}{2}$ –2 mm long beak, strongly and densely many-nerved, when ripe widely spreading or reflexed. Lower bracts much overtopping the inflorescence, scarcely sheathing. . . . . **49. *C. pseudocyperus***
26. Glumes 3–6 mm long, whether or not awned.
27. Utricles nerveless or obscurely few-nerved, except for the 2 marginal veins,  $5$ – $7\frac{1}{2}$  mm long. ♀ Spikelets linear-cylindric, lax-flowered, 2–9 cm by 3–7 mm. Glumes  $3\frac{1}{2}$ –6 mm, oblong to ovate, acute to very obtuse, translucent, with broad white margins and greenish midrib, the latter not reaching the apex, but sometimes excurrent into a short awn up to 1(–2) mm long . . . . . **47. *C. finitima***
27. Utricles (strongly) many-nerved.
28. Utricles  $5\frac{1}{2}$ – $7\frac{1}{2}$  mm, fusiform. Glumes oblong-ovate, acute, very thin, dirty white with 3-nerved greenish central stripe,  $3$ – $5\frac{1}{2}$  mm long, muticous or mucronulate, rarely with a short awn . . . . . **23. *C. jackiana***
28. Utricles  $5$ – $5\frac{1}{2}$  mm. Glumes ovate, deeply emarginate at the top, pale with purplish margins, c. 3 mm long, the strong midrib excurrent into a firm, smooth or scabrid awn as long as the glume . . . . . **60. *C. sp.* (§ *Paludosae*)**
25. Utricles 3–5(–7) mm long; nut at most  $2\frac{1}{2}$  mm long, but mostly shorter; if the utricles are longer than 5 mm, the nut is at most  $1\frac{2}{3}$  mm long.
29. Utricles sparsely to rather densely hispidulous, nerveless except for 2 submarginal nerves,  $3$ – $4\frac{1}{2}$  mm long, with stout,  $1$ – $1\frac{1}{2}$  mm long beak. ♀ Spikelets linear-cylindric,  $1\frac{1}{2}$ –6 cm by  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm. Glumes  $3$ – $4\frac{1}{2}$  mm, with an hispidulous awn up to 1 mm long . . . . . **46. *C. brachyathera***
29. Utricles glabrous, many-nerved or -ribbed.
30. Utricles 4–5(–7) mm long, strongly many-nerved. Glumes  $2$ – $2\frac{1}{2}$  mm, with a 2–4 mm long awn. ♀ Spikelets  $2\frac{1}{2}$ –5 cm by 7–15 mm. Leaves 6–10 mm wide. . . . . **49. *C. pseudocyperus***
30. Utricles 3–4 mm (up to 6 mm in *C. brownii* ssp. *transversa*), strongly many-ribbed or plurinerved. Glumes  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm, excurrent into a  $\frac{1}{2}$ – $3\frac{1}{2}$  mm long awn. ♀ Spikelets  $1\frac{1}{2}$ –12 cm by 4–6 mm. Leaves 2–10 mm wide.
31. Utricles strongly many-ribbed. ♀ Spikelets short-cylindric to cylindric,  $1\frac{1}{2}$ –3 cm by 5–6 mm. Glumes 1–2 mm with a  $\frac{1}{2}$ – $3\frac{1}{2}$  mm long awn. Nut  $2\frac{1}{4}$ – $2\frac{1}{2}$  mm. Leaves 3–4 mm wide . . . . . **43. *C. brownii***
31. Utricles plurinerved. ♀ Spikelets (narrowly) cylindric, ( $1\frac{1}{2}$ –) $2\frac{1}{2}$ –12 cm by 4–6 mm. Nut  $1\frac{1}{2}$ – $2\frac{1}{4}$  mm. Leaves 2–10 mm wide.
32. Plant densely caespitose, without stolons. Lower bracts long sheathing. Utricles olive-brown to fuscous. ♀ Spikelets  $2\frac{1}{2}$ –12 cm long . . . . . **44. *C. oedorrhampha***
32. Plant stoloniferous. Bracts not sheathing. Utricles pale greenish to stramineous. ♀ Spikelets ( $1\frac{1}{2}$ –) $2$ –5 cm . . . . . **42. *C. alopecuroides***
8. Stigmas 2.
33. Utricles densely covered with raised glandular papillae, slenderly nerved or nerveless. At least the lower spikelets subcernuous to pendulous. Lowest bract much overtopping the inflorescence.
34. Glumes acute to obtusish, muticous or only the lower ones excurrent in a short, up to 1 mm long awn. Utricles slenderly nerved, 3–4 mm long . . . . . **53. *C. pruinosa***
34. Glumes truncate or bilobed-emarginate, distinctly awned (awn  $\frac{1}{2}$ –2 mm long). Utricles mostly nerveless,  $2\frac{1}{4}$ – $3\frac{1}{2}$  mm . . . . . **52. *C. phacota***
33. Utricles not papillate, whether minutely punctulate or not.

35. Stems 3–40(–75) cm by 1–1½ mm. Utricles distinctly 8–14-nerved, 2–3½ mm. Spikelets erect or suberect, terminal ♂, remainder ♀ or with a few ♂ flowers at the top, 1–6 cm. Leaves 1½–4 mm wide . . . . . 55. *C. gaudichaudiana*
35. Stems 30–110 cm by up to 4 mm (below). Spikelets nodding, all lateral ones androgynous or 1(–2) at the base of the uppermost much smaller and wholly ♂, (3–)6–13 cm long. Leaves 3–12 mm wide. . . . . 51. *C. graeffeana*
7. Terminal spikelet always bisexual.
36. Terminal spikelet (often all the spikelets) gynaeandrous (*i.e.* ♀ flowers above, ♂ ones below); ♂ flowers often so few that the spikelets have an entirely ♀ appearance.
37. Stigmas 2. Nut lenticular (biconvex or planoconvex).
38. Spikelets all sessile, ½–1½ cm long.
39. Utricles distinctly winged on the margins. Lower bracts foliaceous, long, far exceeding the up to 15 cm long inflorescence . . . . . 65. *C. remota*
39. Utricles wingless. Bracts glumiform, the lowest exceptionally subulate to herbaceous, sometimes exceeding the 1½–3½(–6) cm long inflorescence.
40. Utricles (3–)4–5(–5½) mm long, when mature widely patent to reflexed, distinctly beaked, not whitish-punctulate . . . . . 64. *C. echinata*
40. Utricles 2–2½ mm long, suberect also when mature, scarcely beaked, densely whitish-punctulate . . . . . 66. *C. curta*
38. At least the lowest spikelet peduncled, cernuous, 3–6(–8) cm long . . . . . 54. *C. teres*
37. Stigmas 3. Nut trigonous.
41. Utricles hispidulous or sparsely pubescent. Nut mitrate (*i.e.* contracted at the apex and then expanded into a discoid annulus).
42. Utricles many-nerved. Glumes of ♂ flowers infundibuliform . . . . . 34. *C. tristachya*
42. Utricles obscurely nerved or nerveless. Glumes of ♂ flowers with free margins . . . . . 31. *C. breviculmis*
41. Utricles glabrous. Nut not mitrate.
43. Lower bracts sheathing. Plants caespitose.
44. Utricles broadly ellipsoid to subglobose, 3–4 mm long or ovoid-ellipsoid, 6 mm long . . . . . 43. *C. brownii*
44. Utricles fusiform or fusiform-ellipsoid, 5–7½ mm long.
45. Utricles strongly many-nerved . . . . . 23. *C. jackiana*
45. Utricles nerveless except 2 marginal nerves or obscurely few-nerved . . . . . 47. *C. finitima*
43. Bracts not sheathing. Plants stoloniferous . . . . . 42. *C. alopecuroides*
36. Terminal spikelet and all or most of the other spikelets androgynous (*i.e.* ♂ flowers above, ♀ ones below).
46. Stigmas 3.
47. Leaves pseudopetiolate, 1½–3½ cm wide, the base conduplicate. Stems central, erect, scapiform, the base surrounded by some brown, infundibuliform, up to 10 cm long leaf sheaths. Utricles very long beaked, the beak curved, bulbous at the base (to hold the thickened conical style-base), nearly linear towards the very oblique mouth, the whole beak 3–3½ mm long, the utricle including the beak 6–7 mm long. Inflorescence paniculate with head-like very dense partial inflorescences . . . . . 14. *C. helferi*
47. Leaves not pseudopetiolate (except in *C. commixta*). Other characters not so combined.
48. Spikelets peduncled, in fascicles from at least one of the sheathing bracts, sometimes compound.
49. Utricles densely many-nerved, 5–9½ by 1–2⅓ mm. Spikelets 3–8 mm thick. Nut 3–4 mm long . . . . . 18. *C. perakensis*
49. Utricles nerveless or slenderly few-nerved, 3–6 by ⅔–1 mm. Spikelets 2–3½ mm thick. Nut 1½–3½ mm long . . . . . 19. *C. turrita*
48. Inflorescence racemose or spicate and spikelets peduncled or sessile, single or binate at the nodes or inflorescence a panicle and the secondary panicles single or binate at the nodes. Bracts sheathing or not.
50. Flowering stems arising from the axils of the basal leaves, which are crowded on a short stem and much longer than the flowering stems. Inflorescence racemiform or paniculiform; spikelets 6–30, 8–30 mm long. Bracts usually shorter than the spikelets, with funnel-shaped sheaths and short blade. Nut irregularly rhomboid-ellipsoid or rhomboid-obovoid with faces excavated at base and apex; style flexuous . . . . . 26. *C. cryptostachys*
50. Flowering stems not arising from the axils of the basal leaves.



51. Flowering stems developing from lateral shoots. Inflorescence a narrow, simple panicle, consisting of 6–12 head-like or racemose partial inflorescences each containing 1–8 spikelets 4–10 mm long. Utricles strongly many-nerved,  $2\frac{1}{2}$ –4 mm long. . . . . 21. *C. oligostachya*
51. Flowering stems central.
52. Nut with a stout, cylindric,  $\frac{1}{2}$ – $\frac{3}{4}$  mm wide neck. Style centred in the apical hollow of the nut.
53. Inflorescence spiciform, with 2–10 sessile spikelets. Utricles rhomboid-lageniform,  $4\frac{1}{2}$ –5 mm long . . . . . 29. *C. palawanensis*
53. Inflorescence a slender compound panicle with numerous spikelets. Utricles ellipsoid-rhomboid, c. 4 mm long . . . . . 1. *C. cirrhulosa*
52. Nut without stout cylindric neck. Style not centred in an apical hollow.
54. Lower bracts not or only very shortly sheathing.
55. Inflorescence with 12 to numerous spikelets, spiciform, the lateral spikelets arising from a utriculiform, gibbous prophyll containing a flower or a nut. Stems 3–20(–30) cm tall . . . . . 12. *C. satzumensis*
55. Inflorescence with 1–4 spikelets, or 1–4 heads, each consisting of 1–4 crowded sessile spikelets. The lateral spikelets not arising from a fertile prophyll.
56. Utricles densely hispidulous in the upper  $\frac{2}{3}$ . Glumes densely setulose. Lateral spikelets of the inflorescence sessile, ovoid or subglobose (sometimes absent) 38. *C. tricephala*
56. Utricles at most scabrous at the margins towards the apex, the rest glabrous.
57. Utricles 6–8 mm long, with a c. 3 mm long beak. Glumes 3– $4\frac{1}{2}$  mm long, with a  $1\frac{3}{4}$  mm long awn . . . . . 36. *C. ramosii*
57. Utricles 4– $6\frac{1}{4}$  mm long, with a 1–2 mm long beak. Glumes  $2\frac{1}{2}$ –3 mm long, with a  $\frac{1}{2}$ –1 mm long awn. . . . . 35. *C. malaccensis*
54. Lower bracts long-sheathing.
58. The longer spikelets at least 20 mm.
59. Spikelets many. Utricles 3– $4\frac{1}{2}$  mm. Nut 2–3 mm.
60. Beak of utricles straight. Utricles not inflated, ellipsoid or ellipsoid-obovoid, trigonous, pale to castaneous, slenderly nerved, sparsely to subdensely hispidulous, at least towards the apex. Leaves 2–10 mm broad . . . . . 16. *C. myosurus*
60. Beak of utricles curved. Utricles inflated, obscurely trigonous, ovoid to subglobose, strongly nerved, glabrous except the hispidulous margins towards the apex, at first yellowish green, ultimately red and more or less succulent. Leaves 5–18 mm broad . . . . . 15. *C. baccans*
59. Spikelets 1–many. Utricles 4– $9\frac{1}{2}$  mm (if utricles less than 5 mm, spikelets few). Nut 3–4 mm.
61. Spikelets 2–many, branched (or when not branched the beak of the utricle 2–3 mm). Utricles 5– $9\frac{1}{2}$  mm long, the beak  $1\frac{1}{2}$ –3 mm. Style-base slightly thickened . . . . . 18. *C. perakensis*
61. Spikelets not branched, 1–3(–4), 5–20 cm distant. Utricles 4–7 mm, the beak shorter. Style-base pyramidically thickened . . . . . 37. *C. speciosa*
58. Spikelets never becoming longer than 20 mm.
62. Leaves inserted all over the stem. . . . . 13. *C. hypolytroides*
62. Leaves (sub)basal, often 1–3 higher on the stem.
63. Utricles densely pale to golden hispidulous, 5–6(–8) mm long. Spikelets at least 8 mm long . . . . . 18. *C. perakensis*
63. Utricles different,  $2\frac{1}{4}$ –6 mm long.
64. Nut narrowly discoid-annulate at the apex. Utricles whitish setulose, not inflated. Secondary panicles mostly spiciform . . . . . 8. *C. nodiflora*
64. Nut not narrowly discoid-annulate at the apex, or utricles glabrous, inflated.
65. Leaves often pseudopetiolate, the broader leaves more than 15 mm wide. Spikelets  $\pm$  patent, rather few-flowered, 5–10 mm long. Glumes ovate or oblong-ovate, obtuse or slightly emarginate, 2–3 mm long, the awn  $\frac{1}{2}$ –2 mm. Utricles distinctly trigonous, ellipsoid, with prominent angles and flattish faces, membranous, c. 5-nerved on each face, 4–5(–6, *extra-Mal.*) by  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm, subabruptly beaked, the beak  $1\frac{1}{2}$ –2(–3, *extra-Mal.*) mm long, straight, bidentulate on the ventral side with very oblique mouth . . . . . 2. *C. commixta*
65. Leaves not pseudopetiolate, rarely more than 15 mm wide.
66. Utricles glabrous, whether inflated or not, shiny and conspicuously 2–4-nerved on each face and then glumes mucicous or mucronulate, or dull, 3–5-spongy-ribbed or strongly 5–10-nerved on each face, with oblique, often scabrid beak.

67. Utricles shiny, triquetrous, not inflated, conspicuously few-(c. 2-4)-nerved on each face, olivaceous to reddish-castaneous,  $2\frac{1}{4}$ -5 by  $\frac{1}{2}$ -1 mm, with slender, subulate or scarcely tapering beak which is about as long as the body or slightly longer ( $1-2\frac{1}{2}$  mm long). Glumes  $1\frac{1}{2}$ - $2\frac{1}{2}$  (- $4\frac{1}{2}$ ) mm, about as long as the body of the utricle, muticous or rarely mucronulate . . . . . **4. C. filicina**
67. Utricles rather dull, inflated or subinflated, or at least not triquetrous, strongly spongy 3-5-ribbed on each face or strongly 5-10-nerved. (If different proceed under 66 second lead.)
68. Utricles spongy 3-5-ribbed on each face, stramineous or brown, 2-4 by  $1(-1\frac{1}{2})$  mm, abruptly beaked, the beak usually straight, with oblique mouth often becoming bifid,  $\frac{3}{4}$ - $1\frac{1}{2}$  mm long . . . . . **3. C. cruciata**
68. Utricles strongly many-nerved (5-7 or c. 10 nerves on each face),  $3\frac{1}{2}$ -5 by  $1-2\frac{1}{3}$  mm.
69. Utricles distinctly inflated, obscurely trigonous, c. 10 nerves on each face. The rather compact ♂ part of the spikelets as long as to usually much longer than the ♀ part, rarely shorter. Glumes 2- $3\frac{1}{2}$  mm, with an awn to  $3\frac{1}{2}$  mm. Nut often rostrate . . . . . **6. C. indica**
69. Utricles rhomboid, trigonous, 5-7 nerves on each face. Nut erostrate.
70. The (often plumose) ♂ part of the spikelets shorter than to about as long as the ♀ part. Glumes  $1\frac{1}{2}$ -2 mm, with an awn of 1-3 mm . . . . . **5. C. horsfieldii**
70. The ♂ part longer than the ♀ part of the spikelets. Glumes 2- $2\frac{3}{4}$  mm, with an awn of  $\frac{3}{4}$ -2 mm . . . . . **10. C. stramentitia**
66. Utricles glabrous, or hairy, not inflated, obscurely to conspicuously nerved or spongy-ribbed, the beak bidentate or bidentulate.
71. Glumes distinctly awned, broadly ovate. At least in the lowest glumes of a large part of the spikelets the awn longer than the glume. Utricles with (3-)-4-6 strong nerves on each face, glabrous and smooth (glossy), or hispidulous on the margins in the upper part, light green to stramineous, ( $2\frac{1}{2}$ -)3-4 by  $1-1\frac{1}{4}$  mm, the beak compressed, shorter to about as long as the body of the utricle,  $1-1\frac{1}{2}$  mm long. (If the utricles are hispidulous, see 3. *C. cruciata*.) . . . . . **7. C. lamprochlamys**
71. Glumes whether awned or not, awn never longer than glume.
72. Glumes muticous or mucronulate, rarely awned. Utricles obscurely nerved, only 2 nerves more prominent, glabrous at the base, otherwise densely scabrid-pubescent, blackish fuscous or greenish,  $2\frac{3}{4}$ - $4\frac{1}{2}$  by c. 1 mm; the beak straight, compressed, deeply bidentate, but often originally oblique, blackish fuscous, the mouth with whitish hyaline margins . . . . . **9. C. sarawaketensis**
72. Glumes often awned. Beak of utricles not blackish fuscous, or utricles not scabrid-pubescent except at the base, or characters otherwise combined.
73. Glumes ovate or broadly ovate, acutish or obtuse. Utricles obtusely trigonous, strongly spongy 3-5-ribbed on each face, glabrous, except sometimes on the margins . . . . . **3. C. cruciata**
73. Glumes ovate or narrowly ovate, acute. Utricles distinctly trigonous or triquetrous, more or less distinctly several-nerved to obscurely nerved, glabrous or hairy.
74. The ♂ and ♀ part of the spikelets of same length. Glumes  $1\frac{1}{2}$ - $2\frac{1}{2}$  mm . . . . . **3. C. cruciata**
74. In the longer spikelets the ♂ part much longer than the few-flowered ♀ part. Glumes  $2\frac{1}{2}$ - $4\frac{1}{2}$  mm . . . . . **11. C. vesiculosa**
46. Stigmas 2.
75. Rhizome long-creeping, slender. Leaves canaliculate or convolute, c. 1 mm wide. Spikelets approximate, forming an oblong,  $1-1\frac{1}{2}$  cm long head. Utricles nerveless, glabrous . . . . . **61. C. duriuscula**
75. Rhizome short, plant forming dense tufts. Leaves usually wider than 1 mm.
76. Spikelets very numerous, forming a slender, 5-25 cm long, oblong-cylindric, contracted, spike-like 1-2 cm broad panicle. Leaves with very scabrous margins, 3-10 mm wide. Utricles coriaceous . . . . . **62. C. appressa**
76. Spikelets 4-10(-25), forming a head-like or spike-like 1-3(-5) cm long inflorescence, or spikelets up to 50, in a lax raceme or in (2-)-4-8 fascicles of 2-7 spikelets each and inflorescence up to 50 cm. Utricles membranous.



77. Spikelets all sessile. Cladophylls (see below) absent. Utricles ovate or ovate-lanceolate, not cordate at the base, winged on the margin,  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm long. Glumes mucronate  
63. *C. nubigena*
77. At least the lower spikelets distinctly peduncled. Peduncles of the lateral spikelets at the base surrounded by an ocreiform or utriculiform bracteole (cladophyllum) which is often hidden in the sheath of the bract subtending the spikelet.
78. Bracts not sheathing. Spikelets linear-cylindric, very densely flowered, (2–)6–13 cm long.
79. Utricles densely beset with ferrugineous papillae . . . . . 52. *C. phacota*
79. Utricles epapillate . . . . . 51. *C. graeffeana*
78. Bracts sheathing. Spikelets loosely or somewhat densely flowered, up to  $4\frac{1}{2}$  cm long.
80. Inflorescence very lax, only 1 spikelet at each node. Glumes with a stoutish, up to 5 mm long awn. Utricles glabrous except for the sparsely hispid beak (rarely the margin setulose)  
58. *C. longipes*
80. Spikelets often in fascicles at the nodes. Glumes mucicous or minutely apiculate (rarely an awn up to 2 mm present). Utricles setulose at least on the margins.
81. Lower bract setaceous, suddenly widening into a spathaceous, reddish brown base clasping the base of the spikelets. Glumes 4–6 mm . . . . . 56. *C. bilateralis*
81. Lower bracts foliaceous.
82. Glumes distinctly shorter than to about as long as the utricle, 2–4 mm, rarely some of them to 5 mm. Stigmas shorter than to about as long as the utricles, up to c. 5 mm  
57. *C. brunnea*
82. Glumes about as long as the utricles,  $3\frac{1}{2}$ –5 mm. Stigmas very long (7–12 mm), always much longer than the utricles . . . . . 59. *C. teinogyna*

### I. Subgenus *Carex*

*Carex* subg. *Indocarex* BAILL. Hist. Pl. 12 (1893) 345. — *Primocarex* KÜK. Verh. Bot. Ver. Brandenb. 47 (1905) 204. — *Carex* subg. *Primocarex* KÜK. Pfl. R. Heft 38 (1909) 68.

Type species: *Carex acuta* L.

#### 1. Section *Vigneastra*

TUCKERM. En. Meth. (1843) 10. — *Sect. Vigneastra* [grex] *Indicae* [TUCKERM. l.c., nomen]; ex BAILEY, Proc. Am. Ac. 22 (1886) 98. — *Sect. Indicae* CLARKE, Fl. Br. Ind. 6 (1894) 713; KÜK. Pfl. R. Heft 38 (1909) 260; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 38; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 491, in nota. — *Sect. Polystacheae* CLARKE [ser.] *Stramentitiae*, *Cruciatae* & *Filicinae* CLARKE, J. Linn. Soc. Bot. 37 (1904) 4. — *Sect. Stramentitiae* (CLARKE) NELMES, Reinwardtia 1 (1951) 250, p.p. — *Sect. Cruciatae* (CLARKE) NELMES, l.c. 275. — *Sect. Filicinae* (CLARKE) NELMES, l.c. 286; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 48. — *Sect. Indicae* subsect. *Indicae* KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 151.

Type species: *Carex indica* L. (lectotype).

1. *Carex cirrhulosa* NEES in Hook. J. Bot. Kew Misc. 6 (1854) 29; NELMES, Reinwardtia 1 (1951) 262. — ? *C. densiflora* PRESL, Rel. Haenk. 1 (1828) 204; F.-VILL. Nov. App. (1882) 310. — *C. fuirenoïdes* (non GAUDICH.?) F.-VILL. Nov. App. (1882) 310; CLARKE, J. Linn. Soc. Bot. 37 (1904) 11, p.p.; Philip. J. Sc. 2 (1907) Bot. 107, p.p. — *C. fibrata* BOOTT ex VIDAL, Phan. Cuming. (1885) 156; Rev. Pl. Vasc. Filip. (1886) 286, nomen.

— *C. fuirenoïdes* GAUDICH. var. *cirrhulosa* KÜK. Pfl. R. Heft 38 (1909) 287; Philip. J. Sc. 6 (1911) Bot. 61; MERR. En. Philip. 1 (1923) 138, p.p. — Fig. 118.

*Inflorescence* a slender, compound panicle, continuous above, interrupted below, c. 18 cm long; secondary panicles 6, single at the nodes, erect, oblong, rather dense,  $1\frac{1}{2}$ – $3\frac{1}{2}$  cm long, their lower branches again branched into several sessile, patent,

crowded spikelets on trigonous, smooth or sparsely scabrid peduncles; rachis sparsely scabrid above. Lower bracts foliaceous, much exceeding the inflorescence, stiff, flat or with revolute margins, long-attenuate, long-sheathing, 5–8 mm wide, upper ones much reduced, shortly sheathing. *Spikelets* numerous, androgynous, oblong, ovoid, or subglobose, dense, 4–5 mm long, their ♂ part about as long as the ♀, their bracteoles glumiform, with hispid, often curved awns, c. 10 mm long. *Glumes* ovate or suborbicular, translucent, erose-ciliolate at the apex, otherwise glabrous,  $\frac{3}{4}$ –1 mm long, the midnerve excurrent in a stout, flat, sparsely hispid, straight or slightly curved,  $1\frac{1}{4}$ – $2\frac{1}{2}$  mm long awn. *Utricles* trigonous, ellipsoid-rhomboid, subcoriaceous, patent, strongly many-nerved, glabrous, smooth or very sparsely scabrid at the apex, usually slightly curved, somewhat spongy-thickened at the base, subabruptly narrowed into the beak, pale stramineous to brown, 4 by 1– $1\frac{1}{4}$  mm; beak scarcely tapering, compressed, sparsely scabrid, straight or slightly curved, bidenticulate, with straight mouth,  $1\frac{1}{2}$  mm long. *Nut* triquetrous, with prominent angles and concave faces, ellipsoid-rhomboid, stipitate, the apex narrowed into a short, thick neck expanding into a discoid ring c.  $\frac{1}{2}$  mm diam.,  $2\frac{1}{4}$  by 1– $1\frac{1}{4}$  mm. *Style-base* broadly pyramidal, persistent on the nut, centred in the apical hollow of the nut. Stigmas 3.

Distr. *Malesia*: Philippines (Cebu).

Note. Only known from the type collection (CUMING 1764, collected in 1841), which is represented in BM and K by very defect specimens (rhizome, leaves and parts of the inflorescence missing), so that it is difficult to ascertain its status. CLARKE considered it synonymous with *C. fuire-noides* GAUDICH. from the Marianas, which is *C. indica* L. NELMES supposed affinity with *C. cryptostachys* BRONGN. and the species of *sect. Lageniformes* (OHWI) NELMES, wrongly as I think.

2. *Carex commixta* STEUD. [in Zoll. Syst. Verz. 1 (1854) 60, *nomen*] Syn. 2 (1855) 207; MIQ. Fl. Ind. Bat. 3 (1856) 349; KERN, Blumea 15 (1967) 427, f. 1; in BACK. & BAKH. f. Fl. Java 3 (1968) 491. — *C. horsfieldii* (non BOOTT) MIQ. Fl. Ind. Bat. 3 (1856) 349, p.p. [*quoad specim. Jungh.*]; KÜK. Pfl. R. Heft 38 (1909) 273; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 67. — *C. spatiosa* BOOTT, Ill. 2 (1860) 86, t. 246; BOECK. Linnaea 40 (1876) 349; CLARKE, J. Linn. Soc. Bot. 37 (1904) 12, incl. var. *bogorensis* CLARKE; KÜK. Pfl. R. Heft 38 (1909) 265; CAMUS, Fl. Gén. I.-C. 7 (1912) 188; NELMES, Kew Bull. (1946) 21, 23; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 111; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 40. — *C. blepharolepis* NELMES, Kew Bull. (1946) 18, 23; Reinwardtia 1 (1951) 265. — *C. smitinandii* RAYM. Dansk Bot. Ark. 23 (1965) 255, f. 1. — Fig. 118.

Rhizome shortly creeping, stout, woody. *Stems*

loosely tufted, triquetrous, smooth, 40–100 cm by 2–3 mm, the base clothed with membranous, pale or fuscous bladeless sheaths or their fibrous remains. *Leaves* herbaceous, subbasal and a few higher on the stem, equalling to much longer than the stems, linear-lanceolate, long-attenuate, tapering below (often into a pseudo-petiole), flat, light green, scabrid on the margins,  $1\frac{1}{2}$ –3 cm wide. *Inflorescence* a pale, compound, erect, much interrupted, 15–40 cm long panicle; secondary panicles 2–6, single at the nodes, erect, pyramidal, loose, 3– $7\frac{1}{2}$  by  $1\frac{1}{2}$ –5 cm, upper continuous, lower (when more than 2) distant, on exserted, hispidulous peduncles; rachis densely whitish hispid. Lower bracts foliaceous, exceeding the inflorescence, long-sheathing, upper reduced. *Spikelets* androgynous, subsessile, patulous, rather few-flowered, 5–10 mm long, ♂ and ♀ parts about equal in length. *Glumes* ovate or oblong-ovate, thinly membranous, obtuse or slightly emarginate, slenderly nerved, ciliolate at least at the top, otherwise glabrous or minutely adpressed-hispidulous, pale stramineous to light brown, 2–3 mm long, the midnerve excurrent in an antrorsely scabrid,  $\frac{1}{2}$ –2 mm long awn. *Utricles* distinctly trigonous, ellipsoid with prominent angles and flattish faces, membranous, not inflated, patulous, many-nerved (nerves c. 5 on each face), glabrous or very sparsely hispidulous, rounded at the base, straight or slightly recurved, subabruptly beaked, 4–5(–6) by  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm; beak sparsely scabrid on the margins, or smooth,  $1\frac{1}{2}$ –2(–3) mm long, bidenticulate on the ventral side, with very oblique mouth. *Nut* triquetrous, ellipsoid-rhomboid, not cuneate at the base, erostrate, dark brown with yellowish angles,  $2\frac{1}{2}$ – $2\frac{3}{4}$  by  $1\frac{1}{2}$ – $1\frac{1}{4}$  mm. *Style-base* pyramidally thickened, subpersistent on the nut. Stigmas 3.

Distr. Burma, N. Thailand, Tonkin, Annam, Hainan; in *Malesia*: Sumatra (Bencoolen, Lam-pongs), West and Central Java.

Ecol. Moist places in primary and, less frequently, secondary forests, 800–1500 m, along water-courses sometimes descending to 300 m.

Vern. Java: *ilat harashas*, S.

Note. The type of *C. spatiosa* is from Annam (GAUDICHAUD 67). According to CLARKE, *l.c.*, the Malesian plants should differ by the ovoid utricles with a scabrid beak  $\frac{1}{2}$ – $\frac{3}{4}$  as long as the body, and according to NELMES (1946, *l.c.*) by the shorter, glabrous glumes and the shorter utricles. On the whole the Indochinese specimens have longer utricles (up to 6 mm) because of the slenderer beak, but some of them are indistinguishable from the Malesian plants, which were described as *C. spatiosa* var. *bogorensis* CLARKE and *C. blepharolepis* NELMES.

3. *Carex cruciata* WAHLNB. Vet. Akad. Handl. Stockh. 24 (1803) 149; CLARKE, Fl. Br. Ind. 6 (1894) 715; J. Linn. Soc. Bot. 37 (1904) 9; RIDL. Mat. Fl. Mal. Pen. (Monoc.) 3 (1907) 118; KÜK.



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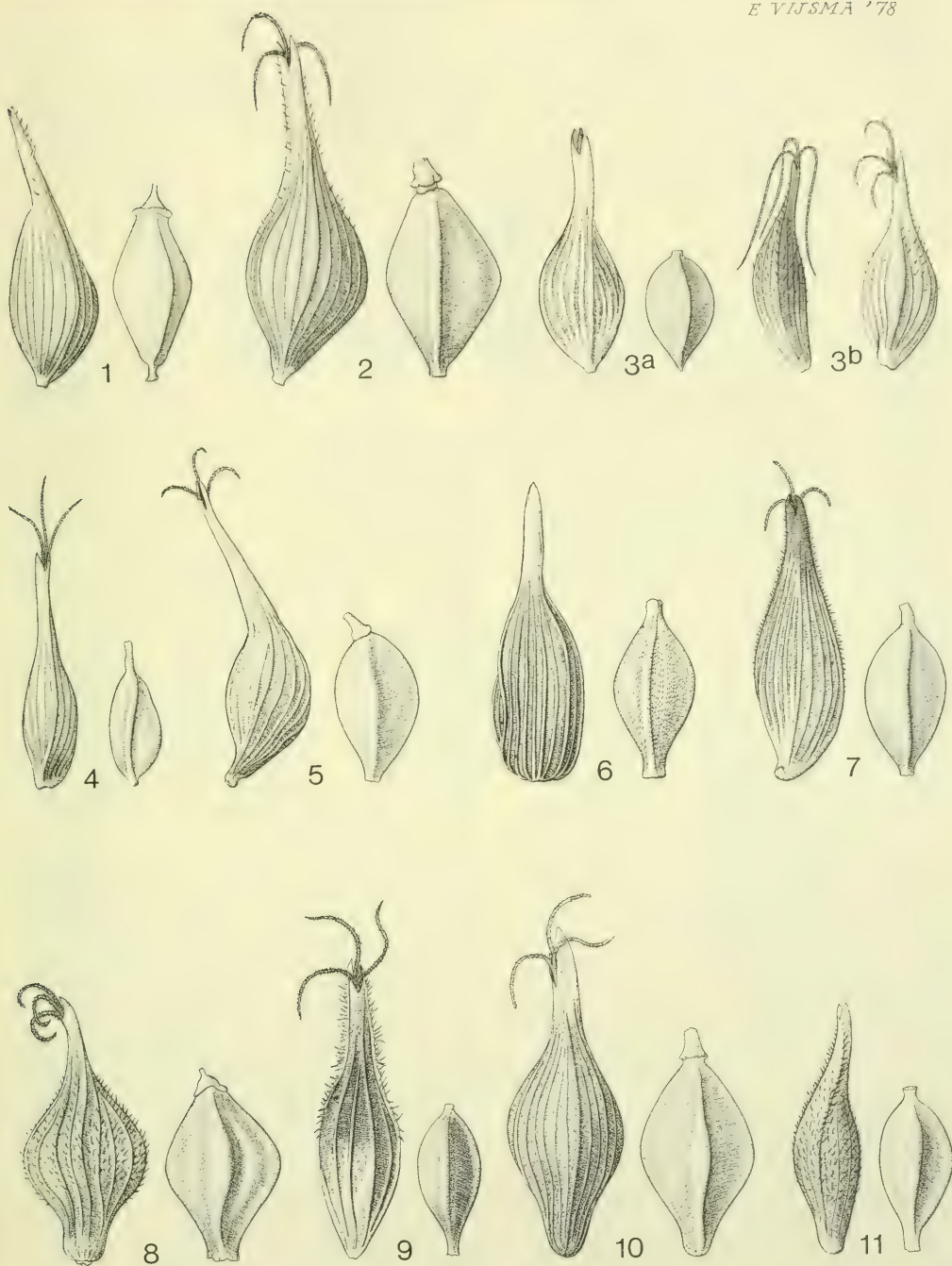


Fig. 118. Utricles and nuts of *Carex*. Species numbered as in the text (1 CUMING 1764, 2 JACOBS 8046, 3a CHEW, CORNER & STANTON 1706, 3b (left) VERHEIJEN 2585, 3b (right) VAN OOSTSTROOM 13154, 4 HARTLEY 11122, 5 NGF 21261, 6 RIDLEY 15721, 7 BRASS 24684, 8 B. F. HERNAY 652, 9 PULLEN 6106, 10 BAKHUIZEN VAN DEN BRINK 6565, 11 VAN STEENIS 4140). All  $\times 10$ .

Pfl. R. Heft 38 (1909) 265; CAMUS, Fl. Gén. I.-C. 7 (1912) 189, f. 27, 5-9; RIDL. Fl. Mal. Pen. 5 (1925) 185; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B 11 (1936) 460; KÜK. Bull. Jard. Bot. Btztg III, 16 (1940) 315; NELMES, Reinwardtia 1 (1951) 277; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 129; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 46; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 153; RAYM. Dansk Bot. Ark. 23 (1965) 254; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 492. — Fig. 118, 124a-d.

*Further synonyms under the varieties.*

Rhizome short or shortly creeping, stout, woody. *Stems* tufted, stout, trigonous, smooth, up to 200 cm by 2-5 mm, surrounded below the leaves by bladeless, dark reddish to blackish sheaths and their fibrous remains. *Leaves* (sub)coriaceous, mostly basal but 1-3 higher on the stem, much exceeding to shorter than the stems, linear, long-attenuate, flat or with revolute margins, scabrid on the margins and the nerves, (3-)5-14 mm wide. *Inflorescence* a slender, usually much elongated, interrupted, decompound, ferrugineous or stramineous panicle up to 70 cm long; secondary panicles 3-12, at 3-8 nodes, all or the middle ones binate at the nodes or all single, erect or suberect, oblong-linear or (broadly) oblong-lanceolate or ovoid-subpyramidal, loose to dense, 5-10 cm long, the upper approximate, the lower distant on unequal scabrid or smooth peduncles; rachis scabrid-hispid or hispidulous on the angles. Lower bracts foliaceous, equalling or exceeding the inflorescence, long-sheathing, upper much reduced; bracteoles excurrent in a slender, ciliolate-scabrid, often recurved awn. *Spikelets* (very) numerous, androgynous, obliquely patent or divaricate, 4-8 (-10) mm long, ovoid to oblong, the ♂ part as long as or somewhat longer than the ♀ part. *Glumes* broadly ovate, ovate or ovate-lanceolate, acute to very obtuse, membranous, (sub)translucent, glabrous or sparsely hispidulous, with reddish brown to dark brown streaks,  $1\frac{1}{4}$ -3 mm long, several-nerved, the midnerve of the lower ones acute or excurrent in a smooth or hispidulous, up to 1 mm long awn. *Utricles* distinctly or obtusely trigonous, not inflated or subinflated, (broadly) ellipsoid to ovoid, membranous or subcoriaceous, patulous or patent, straight or slightly recurved, often finally recurved, more or less distinctly several-(spongy)-nerved, glabrous or sparsely hispidulous, (sub)abruptly beaked, stramineous or brown with reddish brown streaks and spots, 2-4 by  $\frac{4}{5}$ -1(- $1\frac{1}{2}$ ) mm; beak slender, smooth or scabrid on the margins, ( $\frac{3}{4}$ )-1- $1\frac{1}{2}$  mm long, with oblique but soon bidenticulate to bifid mouth. *Nut* distinctly trigonous, with prominent angles and flat or concave sides, (ovoid-)ellipsoid, not or scarcely beaked, scarcely stipitate, stramineous to brown or blackish,  $1\frac{1}{2}$ -2 $\frac{1}{4}$  by  $\frac{3}{4}$ -1 mm. *Style-base* not or slightly thickened. Stigmas 3.

*Distr.* Widely spread, from India through SE.

Asia to S. China, Formosa and the Ryu Kyu Is.; throughout *Malesia*.

*Note.* Several collections from Sumatra: VAN BORSSUM WAALKES 2753, BÜNNEMEIJER 2530 (type of *C. buennemeijeri* NELMES), 3644, 3880, 4126, 4651, are intermediate between *var. cruciata* and *var. rafflesiana*.

#### KEY TO THE VARIETIES

1. Leaves usually much exceeding the stem. Inflorescence stramineous. Utricles strongly spongy 3-5-ribbed on each face

##### a. *var. cruciata*

1. Leaves usually as long as the stems or shorter. Inflorescence ferrugineous. Utricles more or less distinctly 3-7-nerved on each face

##### b. *var. rafflesiana*

a. *var. cruciata*. — *C. cruciata* WAHLENB. Vet. Akad. Handl. Stockh. 24 (1803) 149; RIDL. Fl. Mal. Pen. 5 (1925) 185, incl. *var. condensata* RIDL. — *C. bengalensis* ROXB. Fl. Ind. ed. Carey 3 (1832) 572; BOOTT, Ill. 2 (1860) 85, t. 240-243; BOECK. Linnaea 40 (1876) 346, excl. *varieties*. — *C. condensata* NEES in Wight, Contr. (1834) 123; CLARKE, Fl. Br. Ind. 6 (1894) 716; BOOTT, Ill. 2 (1860) 86, t. 247-248. — *C. vacua* BOOTT ex BOECK. Linnaea 40 (1876) 343, p.p. (excl. *pl. jav.*). — *C. valida* NEES in Wight, Contr. (1834) 123, p.p.; KUNTH, En. 2 (1837) 513, p.p. — *C. continua* CLARKE, Fl. Br. Ind. 6 (1894) 717. — ? *C. repanda* CLARKE *var. implumis* CLARKE, J. Linn. Soc. Bot. 37 (1904) 9. — *C. galactolepis* NELMES, Kew Bull. (1946) 20; Reinwardtia 1 (1951) 279. — *C. spongocrepis* NELMES, Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 128. — Fig. 118, 124a-b.

Rhizome shortly creeping. *Stems* 40-150 cm. *Leaves* coriaceous, usually much exceeding the stems. *Inflorescence* stramineous, continuous above, usually interrupted below, 15-60 cm long; secondary panicles 3-11, at 3-8 nodes, usually all single at the nodes, sometimes binate at the middle nodes, erect, broadly lanceolate or ovoid-subpyramidal, rather dense to dense, on stiff, smooth or scabrid peduncles long-exserted from the sheaths, up to 10 cm long; rachis hispidulous on the angles. Lower bracts slightly to much exceeding the inflorescence. *Spikelets* very numerous, divaricate, rather dense, 5-8(-10) mm long, the ♂ part as long as or somewhat longer than the ♀ part. *Glumes* ovate or broadly ovate, acutish to very obtuse, thinly membranous, translucent, several-nerved, glabrous, with ferrugineous to dark brown streaks,  $1\frac{3}{4}$ -3 mm long. *Utricles* obtusely trigonous, subinflated, ovoid or broadly ellipsoid, membranous, patent, finally recurved, strongly spongy-ribbed (nerves 3-5 on each face), glabrous, rarely sparsely setulose at the apex, often with spongy-thickened base, abruptly beaked, stramineous or brown, purplish spotted,  $2\frac{1}{2}$ -3(-4) by



E. VIJLSMA '78

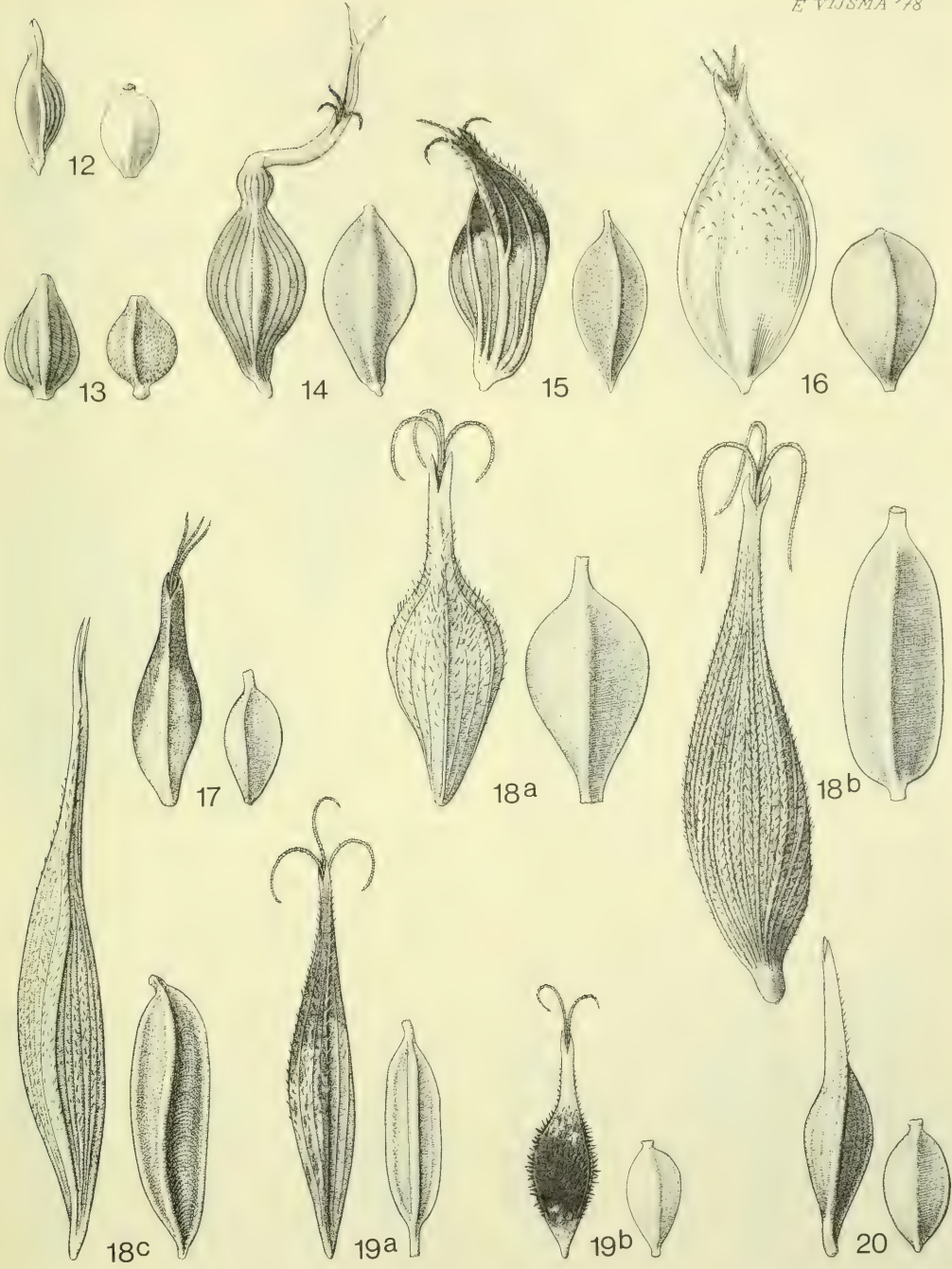


Fig. 119. Utricles and nuts of *Carex*. Species numbered as in the text (12 SANTOS 5776, 13 BÜNNEMEIJER 9820, 14 BACKER 22996, 15 ELBERT 62, 16 VAN OOSTSTROOM 13293, 17 NGF 39555, 18a VAN STEENIS 8277, 18b BROOKE 8561, 18c VAN STEENIS 8461, 19a ANU 15532, 19b SANTOS 5785, 20 MEIJER 6127). All  $\times 10$ .

1-(1 $\frac{1}{2}$ ) mm; beak usually straight, smooth or sparsely scabrid on the margins, with oblique mouth often becoming bifid, ( $\frac{3}{4}$ )-1-1 $\frac{1}{2}$  mm long. *Nut* with flat or slightly concave sides, ovoid-ellipsoid, olive-brown to blackish, 2-2 $\frac{1}{4}$  by  $\frac{9}{10}$ -1 mm. *Style-base* slightly thickened.

Distr. Widely spread, from India through SE. Asia to S. China, Formosa, the Ryu Kyu Is., and Queensland; in *Malesia*: Malay Peninsula, Sumatra, N. Borneo.

Ecol. In savannahs, open places in mountain forests, forest-borders, along river-banks, 1100-1500 m.

Vern. *Rija-rija*.

Note. Very variable; sometimes hard or impossible to distinguish from *var. rafflesiana*, especially in Sumatra. The type specimens of *C. galactolepis* (KING's coll. 106) and *C. repanda var. implumis* (WRAY 1982) are too poor to be certain of their affinity.

**b. var. rafflesiana** (BOOTT) NOOT., *stat. nov.* — *C. rafflesiana* BOOTT, Trans. Linn. Soc. 20 (1846) 132; Ill. 1 (1858) 12, t. 33; CLARKE, J. Linn. Soc. Bot. 37 (1904) 10, *incl. var. tenuior* CLARKE; KÜK. Pfl. R. Heft 38 (1909) 282, *incl. var. macrothyrsa* KÜK. *et var. scaberrima* KÜK.; Philip. J. Sc. 6 (1911) Bot. 59, *incl. var. scaberrima* KÜK. *et var. continua* KÜK.; MERR. En. Philip. 1 (1923) 140, *incl. var. scaberrima* KÜK. *et var. continua* KÜK.; KÜK. in Hochr. Candollea 6 (1936) 430, *incl. var. minor* KÜK.; NELMES, Reinwardtia 1 (1951) 290, *incl. var. macrothyrsa* KÜK. *et var. virgata* NELMES; *ibid.* 2 (1954) 376; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 153, *incl. var.*; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 492. — *C. macrothyrsa* MIQ. Fl. Ind. Bat. 3 (1856) 351. — *C. virgata* MIQ. l.c., *non* SOL. ex BOOTT, 1853. — *C. pentacarpa* BOECK. Flora 58 (1875) 265. — *C. vacua* BOOTT ex BOECK. Linnaea 40 (1876) 343, p.p. (*pl. jav.*). — *C. bengalensis var. virgata* BOECK. *et var. scaberrima* BOECK. l.c. 347. — *C. continua* [*non* CLARKE, Fl. Br. Ind. 6 (1894) 717] CLARKE, J. Linn. Soc. Bot. 37 (1904) 11; Philip. J. Sc. 2 (1907) Bot. 107; KÜK. Pfl. R. Heft 38 (1909) 282, p.p.; NELMES, Reinwardtia 1 (1951) 299; *ibid.* 2 (1954) 376. — *C. gembolensis* CLARKE *var. timorensis* CLARKE, J. Linn. Soc. Bot. 37 (1904) 10. — *C. scaberrima* CLARKE, l.c. 10; Philip. J. Sc. 2 (1907) Bot. 107; Kew Bull. add. ser. 8 (1908) 72. — *C. clarkeana* KÜK. Bull. Herb. Boiss. II, 4 (1904) 52, *ex descr.*; Pfl. R. Heft 38 (1909) 282; RIDL. Fl. Mal. Pen. 5 (1925) 183; NELMES, Reinwardtia 1 (1951) 288. — *C. pycnothyrsos* KÜK. Philip. J. Sc. 6 (1911) Bot. 60; MERR. En. Philip. 1 (1923) 140; NELMES, Reinwardtia 1 (1951) 282; *ibid.* 2 (1954) 374, *descr.* — *C. semiglomerata* KÜK. Bull. Jard. Bot. Btzg III, 16 (1940) 315; in Fedde, Rep. 53 (1944) 106; NELMES, Reinwardtia 1 (1951) 285; *ibid.* 2 (1954) 376. — *C. sarawaketensis* KÜK. *var. brevirostris* KÜK. Bot. Jahrb. 70 (1940) 464. — *C. timorensis* (CLARKE)

NELMES, Kew Bull. (1946) 24; Reinwardtia 1 (1951) 242, 287. — *C. spongoneura* NELMES, Kew Bull. (1946) 18; Reinwardtia 1 (1951) 281. — *C. xestogyne* NELMES, Kew Bull. (1946) 16; Reinwardtia 1 (1951) 311. — *C. buennemeijeri* NELMES, Kew Bull. (1950) 191; Reinwardtia 1 (1951) 283; *ibid.* 2 (1954) 376. — *C. oblonga* NELMES, Kew Bull. (1950) 192; Reinwardtia 1 (1951) 297. — *C. ceramica* NELMES, Kew Bull. (1950) 193; Reinwardtia 1 (1951) 319; *ibid.* 2 (1954) 376. — **Fig. 118, 124c-d.**

Rhizome short. *Stems* up to 200 cm. *Leaves* subcoriaceous, mostly as long as or shorter than the stems. *Inflorescence* ferrugineous, interrupted, up to 70 cm long; secondary panicles 8-12, at 4-6 nodes, all or the middle ones binate at the nodes, or single in depauperate specimens, erect or suberect, oblong-linear or oblong-lanceolate, loose or rather dense, 5-10 cm long, the lower on unequally exerted scabrid peduncles; rachis scabrid-hispid on the angles. Lower bracts equaling or exceeding the inflorescence. *Spikelets* numerous, obliquely patent, 4-7 mm long, the ♂ and ♀ part about equal in length. *Glumes* ovate or ovate-lanceolate, acute, membranous, subtranslucent, glabrous or sparsely hispidulous, with ferrugineous streaks, 1 $\frac{1}{2}$ -2 $\frac{1}{2}$  mm long. *Utricles* distinctly trigonous, not inflated, ellipsoid or ovoid-ellipsoid, membranous or subcoriaceous, patulous, straight or slightly recurved, more or less distinctly 3-7-nerved, glabrous or sparsely hispidulous, subabruptly beaked, stramineous with reddish brown streaks and spots, 2-4 by  $\frac{4}{5}$ -1 mm; beak slender, scabrid on the margins, 1-1 $\frac{1}{2}$  mm long, with oblique but soon bidenticulate mouth. *Nut* with concave sides, ellipsoid, stramineous to brown, 1 $\frac{1}{2}$ -2 by  $\frac{3}{4}$ -1 mm. *Style-base* not or scarcely thickened.

Distr. Thailand, Formosa (Kotosho Is.), Queensland; throughout *Malesia*.

Ecol. Primary forests, forest edges, grassy slopes, sometimes in dry sunny places, 500-2400 m.

Vern. Java: *ilateun*, S; Philippines: *chidak*, Ig., *ikidsan*, Klg., *taláyid*, *tamalang*, Bag.

**4. Carex filicina** NEES in Wight, Contr. (1834) 123; KUNTH, En. 2 (1837) 510; BOOTT, Ill. 3 (1862) 105, t. 311-318; BOECK. Linnaea 40 (1876) 352; O. K. Rev. Gen. Pl. 2 (1891) 748, *incl. var. laevis* O. K. *et var. ciliata* O. K.; CLARKE, Fl. Br. Ind. 6 (1894) 717; J. Linn. Soc. Bot. 37 (1904) 11; KÜK. Pfl. R. Heft 38 (1909) 274, *incl. var. saturata* (CLARKE) KÜK.; CAMUS, Fl. Gén. I.-C. 7 (1912) 191; MERR. En. Philip. 1 (1923) 137; NELMES, Reinwardtia 1 (1951) 304, *incl. var. angustifolia* NELMES *et var. zipellii* NELMES; *ibid.* 2 (1954) 376; AKIYAMA, Car. Far East Reg. Asia (1955) 138, t. 124; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 48; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 152. — *C. nilagirica* STEUD. Syn. 2 (1855) 207. — *C. neoguineensis* CLARKE, J. Linn. Soc. Bot. 37



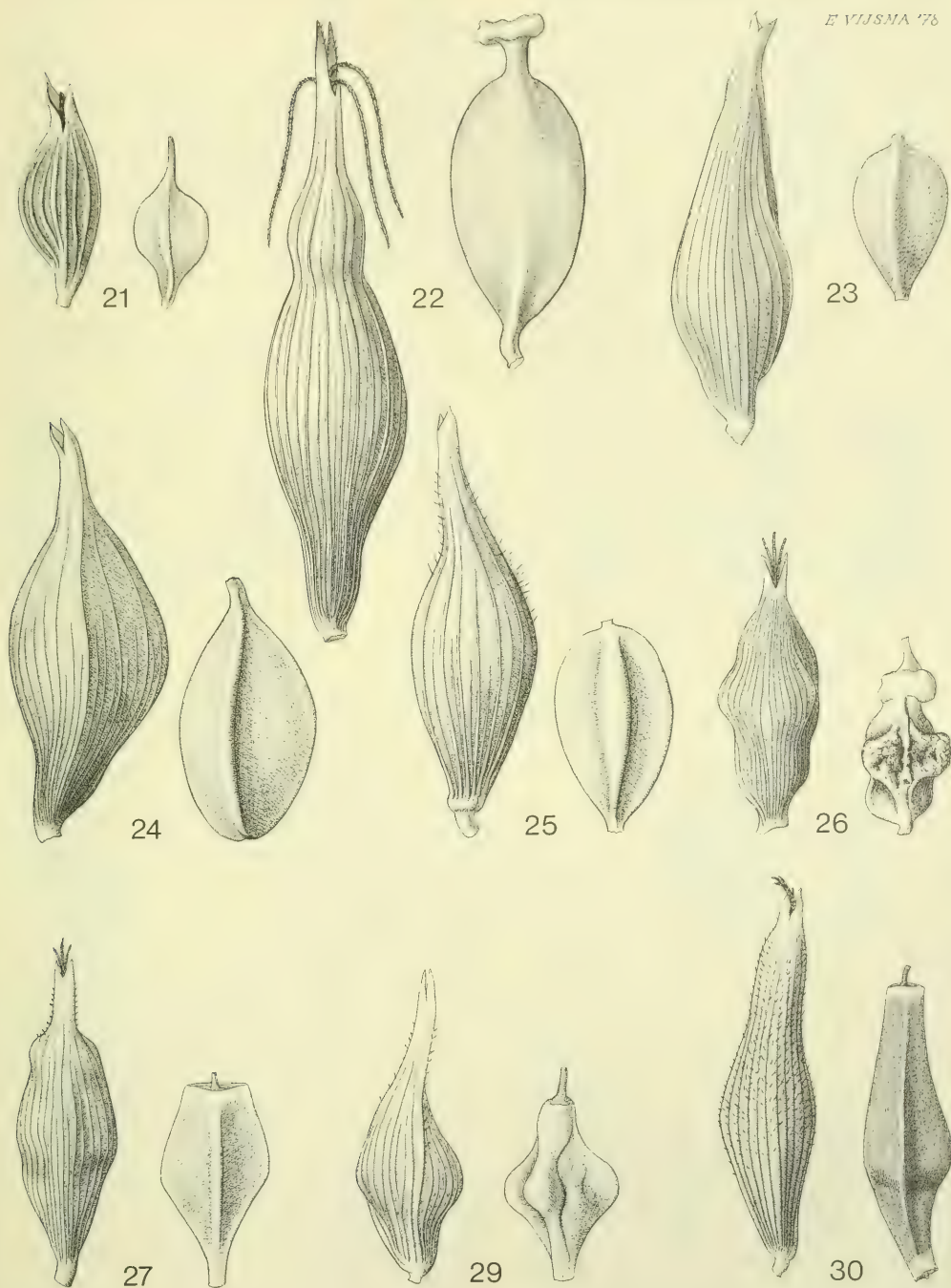


Fig. 120. Utricles and nuts of *Carex*. Species numbered as in the text (21 VANOVERBERGH 323, 22 DE WILDE c.s. 13535, 23 VAN STEENIS 4579, 24 KAUDERN 333, 25 BS 45002, 26 MEIJER 688, 27 LÖRZING 6678, 29 ELMER 13146, 30 MERRILL 512). All  $\times 10$ .

(1904) 12; KÜK. Pfl. R. Heft 38 (1909) 280; S. T. BLAKE, J. Arn. Arb. 28 (1947) 105; NELMES, Reinwardtia 1 (1951) 308; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 492. — *C. saturata* CLARKE, J. Linn. Soc. Bot. 37 (1904) 12; NELMES, Reinwardtia 1 (1951) 302. — *C. filicina* NEES f. *saturata* KÜK. Philip. J. Sc. 6 (1911) Bot. 59. — *C. sclerioides* RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 247; NELMES, Reinwardtia 1 (1951) 307. — *C. ceylanica* BOECK. var. *saturata* KÜK. in Hochr. Candollea 6 (1936) 431. — *C. sarawaketensis* KÜK. var. *glabrinux* KÜK. Bot. Jahrb. 70 (1940) 464. — Fig. 118.

Rhizome short, stout, woody. Stems loosely tufted, slender to stout, trigonous, smooth, up to 150 cm by 6 mm near the base, surrounded below the leaves by bladeless, reddish or blackish sheaths. Leaves herbaceous to subcoriaceous, mostly basal but some spaced on the stem, as long as or shorter than the stems, linear, long-attenuate, flat or with revolute margins, scabrid on the margins, (2-)7-20 mm wide. Inflorescence a slender, interrupted or continuous, decomposed, fuscous panicle up to 60 cm long; partial panicles 5-13, at 4-8 nodes, single and (middle ones) binate, oblong-lanceolate or pyramidal, erect, rather loose to very dense, up to 12 by 2-5 cm, the upper approximate, the lower usually distant on smooth or scabrid, unequally exerted peduncles; rachis smooth towards the base, hispidulous above. Lower bracts foliaceous, shorter than to slightly exceeding the inflorescence, long-sheathing, the upper much reduced; bracteoles excurrent into a hispidulous awn. Spikelets very numerous, androgynous, oblong, rather loose, 4-15(-20) mm long, the ♂ part shorter than to about as long as the ♀ part. Glumes ovate-lanceolate, acuminate, muticous, rarely minutely mucronulate, membranous, subtranslucent, glabrous or the lower ones hispidulous, finely nerved, ferruginous, often darker streaked,  $1\frac{1}{2}$ -2 $\frac{1}{2}$ (-4 $\frac{1}{2}$ ) mm long (about as long as the body of the utricle). Utricles triquetrous, not inflated, ellipsoid, membranous, patent, eventually arcuately recurved, conspicuously 2-4-nerved on each face, glabrous, smooth, often shiny, subabruptly beaked, olivaceous to reddish-castaneous, (2 $\frac{1}{4}$ -)3-5 by  $\frac{1}{2}$ -1 mm; beak slender, subulate (scarcely tapering), smooth, or very sparsely scabrid on the margins, (1-) $1\frac{1}{2}$ -2(-2 $\frac{1}{2}$ ) mm long (about as long as the body or slightly longer); mouth very oblique (the base  $\frac{1}{2}$ - $\frac{3}{4}$  mm from the apex). Nut trigonous, ellipsoid, beaked, closely filling the utricle,  $1\frac{1}{4}$ -1 $\frac{3}{4}$  by  $\frac{1}{2}$ -1 mm. Style-base slightly thickened. Stigmas 3.

Distr. Ceylon and India to S. China, Formosa, Tonkin, Laos and Annam; probably throughout Malesia, in the Lesser Sunda Is. only known from Lombok and in the Malay Peninsula from Pahang.

Ecol. Wet openings in primary forests, in subalpine shrub vegetation, on grassy slopes, along river-banks, 1350-3750 m.

Vern. Philippines: *silak*, *táan*, Ig., *taláyig*, Bag.

Notes. In the circumscription here accepted very variable in all its parts. Numerous segregates have been described, but typical *C. filicina* from India and the aberrant forms from New Guinea are connected by all sorts of intermediates. Typical *C. neoguineensis* is characterized by its dense, often darker inflorescence, and the utricles more scabrid on the beak (usually smooth or almost so in typical *C. filicina*).

The high variability of *C. filicina* also in India is amply discussed and excellently figured by BOOTT, l.c.

The few specimens on which *C. sarawaketensis* var. *glabrinux* KÜK. was based are more or less transitional to 9. *C. sarawaketensis*.

5. *Carex horsfieldii* BOOTT, Proc. Linn. Soc. Lond. 1 (1845) 257; Ill. 1 (1858) 11, t. 32; Miq. Fl. Ind. Bat. 3 (1856) 349, p.p. (*quoad specim. Horsf.*); CLARKE, J. Linn. Soc. Bot. 37 (1904) 11; NELMES, Reinwardtia 1 (1951) 269 (*incl. var. major* NELMES?); *ibid.* 2 (1954) 374; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 44; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 492. — *C. fleckeri* NELMES, Kew Bull. (1939) 313, *fide* NELMES 1951. — Fig. 118, 124e-g.

Rhizome very short, stout, woody. Stems loosely tufted, obtusely trigonous, smooth, 50-100 cm by 2-4 mm, the base clothed with fuscous, bladeless sheaths and comose by their fibrous, fuscous to blackish remains. Leaves herbaceous, subbasal and a few higher on the stem, exceeding the stems, linear, long-attenuate, flat or with revolute margins, greyish-glaucous, scabrid on the margins in the upper part, 5-15 mm wide. Inflorescence a pale, decomposed, erect, much interrupted, 20-40 cm long panicle; secondary panicles 5-8, single at the nodes, erect, oblong-ovoid, loose, distant, up to 10 cm long; peduncles smooth below, scabrid above, the lower much exerted from the sheaths, upper shortly; rachis hispid on the angles. Spikelets androgynous, widely patent, finally almost squarrose, sessile, 5-15 mm long, the ♂ part shorter than to about as long as the ♀ part. Glumes ovate, obtuse (the lower ones truncate to emarginate), membranous, glabrous or sparsely hispidulous, not ciliate, slenderly nerved, whitish,  $1\frac{1}{2}$ -2 by 1-1 $\frac{1}{2}$  mm, the midnerve excurrent in an antorsely scabrid, curved, 1-3 mm long awn. Utricles distinctly trigonous, rhomboid, with prominent angles and flat faces, membranous, not inflated, strongly many-nerved (nerves c. 5-7 on each face), glabrous, patent, arcuately recurved, gradually tapering to the base, suddenly narrowed above into the beak, olive-brown,  $3\frac{1}{2}$ -4 $\frac{1}{2}$  by 1-1 $\frac{1}{4}$  mm; beak strongly recurved, smooth or very sparsely scabrid,  $1\frac{1}{2}$ -2 mm long; mouth dorsally very oblique, not bidentate. Nut trigonous, rhomboid-ellipsoid, erostrate, dark brown with prominent pale angles,



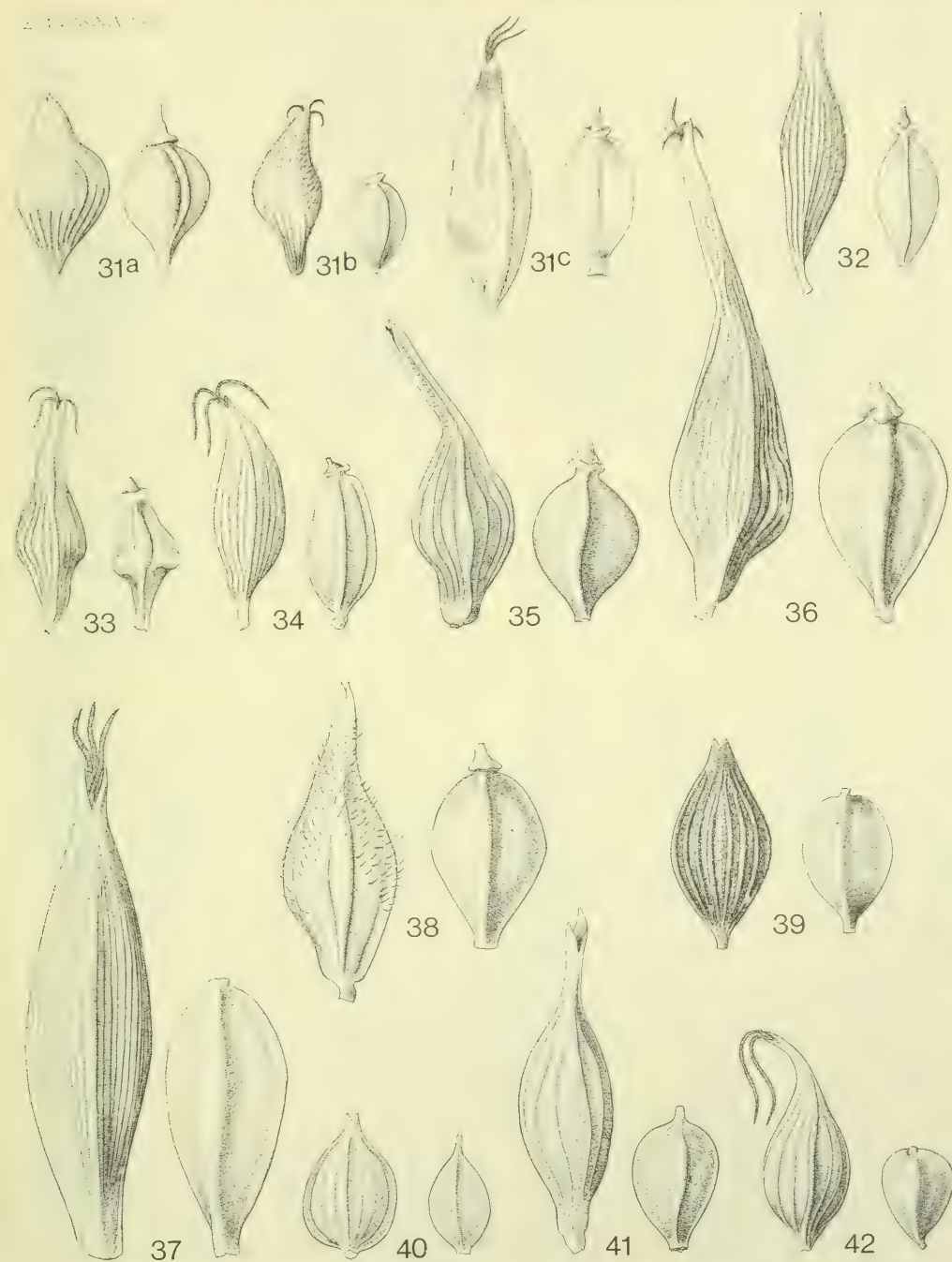


Fig. 121. Utricles and nuts of *Carex*. Species numbered as in the text (31a BRASS 4697, 31b EYMA 864, 31c BRASS 9032, 32 SANTOS 5394, 33 EDANO 17857, 34 ROBBINS s.n., 35 ROBINSON 6186, 36 RAMOS 20990, 37 LÖRZING 16274, 38 BACKER 20462, 39 DE WILDE c.s. 13325, 40 KALKMAN 5213, 41 BRASS 10255, 42 JERMY 4274). All  $\times 10$ .

2–2¼ by 1–1½ mm. *Style-base* pyramidally thickened at the base. Stigmas 3.

Distr. Burma, Thailand, Annam (var. *annamica* RAYM.), Queensland (*C. fleckeri* NELMES); in Malasia: West to East Java, Moluccas, New Guinea.

Ecol. Primary and secondary forests, 100–1100 m.

Vern. Java: *irissan*, J; New Guinea: *homuma*, Garaina.

Notes. *C. horsfieldii* var. *major* NELMES, from Tanimbar Is., P. Jamdena ("utricles 5.2–5.8 mm long, straight or slightly recurved, beak 2.5–2.8 mm long"), was based on a young, very poor collection.

KÜKENTHAL and others misapplied the name *C. horsfieldii* to the Javan plants of *C. commixta* STEUD., while *C. horsfieldii* itself has often been misidentified as *C. indica* L., from which species it chiefly differs in the shorter ♂ part of the spikelets, and the strongly recurved, distinctly trigonous, not inflated, less densely nerved utricles.

6. *Carex indica* LINNÉ, Mant. 2 (1771) 574; MIQ. Fl. Ind. Bat. 3 (1856) 350; BOOTT, Ill. 2 (1860) 87, t. 250–254; BOECK. Linnaea 40 (1876) 347; CLARKE, Fl. Br. Ind. 6 (1894) 714, incl. var. ? *laetebrunnea* CLARKE et var. *milnei* BOOTT ex CLARKE; J. Linn. Soc. Bot. 37 (1904) 8; RIDL. Mat. Fl. Mal. Pen. (Monoc.) 3 (1907) 117; KÜK. Pfl. R. Heft 38 (1909) 262, f. 40, incl. var. *fissilis* (BOOTT) KÜK., *saltem quoad specim. males.*; CAMUS, Fl. Gén. I.-C. 7 (1912) 187; MERR. En. Philip. 1 (1923) 138; RIDL. Fl. Mal. Pen. 5 (1925) 185; NELMES, Reinwardtia 1 (1951) 271; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 42; Dansk Bot. Ark. 23 (1965) 253; KERN in BACK. & BAKH. f. Fl. Java 3 (1968) 492. — *C. fuirenoides* GAUDICH. Freyc. Voy. Bot. (1826) 412. — *C. moritzii* STEUD. [in Zoll. Syst. Verz. 1 (1854) 60, *nomen!*] Syn. 2 (1855) 207; MIQ. Fl. Ind. Bat. 3 (1856) 350; BOECK. Linnaea 40 (1876) 350. — *C. dietrichiae* BOECK. Flora 58 (1875) 122; CLARKE, J. Linn. Soc. Bot. 37 (1904) 8; S. T. BLAKE, J. Arn. Arb. 28 (1947) 102; NELMES, Reinwardtia 1 (1951) 273; Kew Bull. 2 (1955) 303. — *C. fuirenoides* (non GAUDICH.?) CLARKE, J. Linn. Soc. Bot. 37 (1904) 11; Philip. J. Sc. 2 (1907) Bot. 107, p.p.; KÜK. Pfl. R. Heft 38 (1909) 287, p.p.; MERR. En. Philip. 1 (1923) 138, p.p. — Fig. 118, 124j–k, 125.

Rhizome shortly creeping, woody. *Stems* loosely tufted, triquetrous, smooth, (15–)60–100 cm by 1–3 mm, surrounded below the leaves by bladeless, brownish to blackish sheaths and their fibrous remains. *Leaves* subcoriaceous, mostly basal but some higher on the stem, as long as or longer than the stems, linear, long-attenuate, flat or with slightly revolute margins, scabrid on the margins and the nerves above, 5–15 mm wide; sheaths blackish-nerved. *Inflorescence* a decompound, erect, interrupted panicle occupying the upper half of the stem; secondary panicles 3–8, single at the

nodes, erect, oblong-pyramidal, rather loose to dense, the upper approximate, the lower distant on long-exserted peduncles, up to 10 cm long; rachis sparsely hispidulous on the angles. Lower bracts foliaceous, exceeding the inflorescence, long-sheathing, their sheaths glabrous, or hispidulous at the mouth; upper bracts much reduced; bracteoles with a filiform, usually long and recurved awn. *Spikelets* divaricate, androgynous, rather dense, (5–)10–20 mm long, the ♂ part as long as to (usually) much longer than the ♀ part. *Glumes* thinly membranous, ovate or ovate-lanceolate, acute or obtuse, sometimes slightly emarginate, nerved, glabrous, stramineous to brownish, 2–3½ mm long, the midnerve excurrent into an antrorsely scabrid, recurved, up to 3½ mm long awn. *Utricles* inflated, obsoletely trigonous, broadly ellipsoid to subglobose, patent, straight or almost so, subcoriaceous, strongly many-nerved (nerves c. 10 on each face), glabrous, scarcely stipitate, abruptly beaked, olive-brown, 3½–5 by 1½–2½ mm; beak straight or slightly bent, 1½–2 mm long; mouth oblique, not bidentate. *Nut* triquetrous, with very prominent angles and concave faces, broadly ellipsoid-obovoid to subglobose, pyriform, or rhomboid, scarcely stipitate, sometimes slightly discoid-annulate at the apex, often with a curved or straight, dark brown to blackish rostrum, 2–3 by 1½–2 mm. *Style-base* pyramidally thickened, subpersistent on the nut. Stigmas 3.

Distr. Widely distributed, from Ceylon and India through Burma, Thailand, Indo-China and S. China to Queensland, New Caledonia, Carolines, Solomon and Fiji Is.; in Malasia: Malay Peninsula, W. Java (only once collected near Tjikoya by ZOLLINGER), Borneo, SE. & N. Celebes (2 collections), Philippines (Luzon, Samar, Palawan), New Guinea.

Ecol. Moist places in forests, along streams, at low and medium altitudes, up to 1000 m.

Vern. *Bundung*, *sesayak*, M.

Notes. Very variable, especially in the length of the awns on bracteoles and glumes. When KOYAMA, Micronesica 1 (1964) 108–109, says that in *C. indica* the glumes gradually taper to the cuspidate apex without any conspicuous awn, in contradistinction to the Micronesian *C. fuirenoides* GAUDICH. with truncate or shallowly emarginate glumes with a long, scabrous awn, he cannot have had true *C. indica* before him.

Segregation of *C. dietrichiae* (= *C. indica* var. *laetebrunnea*) on account of the darker glumes appears to be impossible. See RAYMOND 1959, l.c., who is in all probability right in supposing that in general NELMES referred young plants to *C. indica*, and those with mature fruits, in which the glumes have often become darker, to *C. dietrichiae*.

7. *Carex lamprochlamys* S. T. BLAKE, J. Arn. Arb. 28 (1947) 104, f. 2A; NELMES, Kew Bull. (1949)



E. VIJSSMA '78

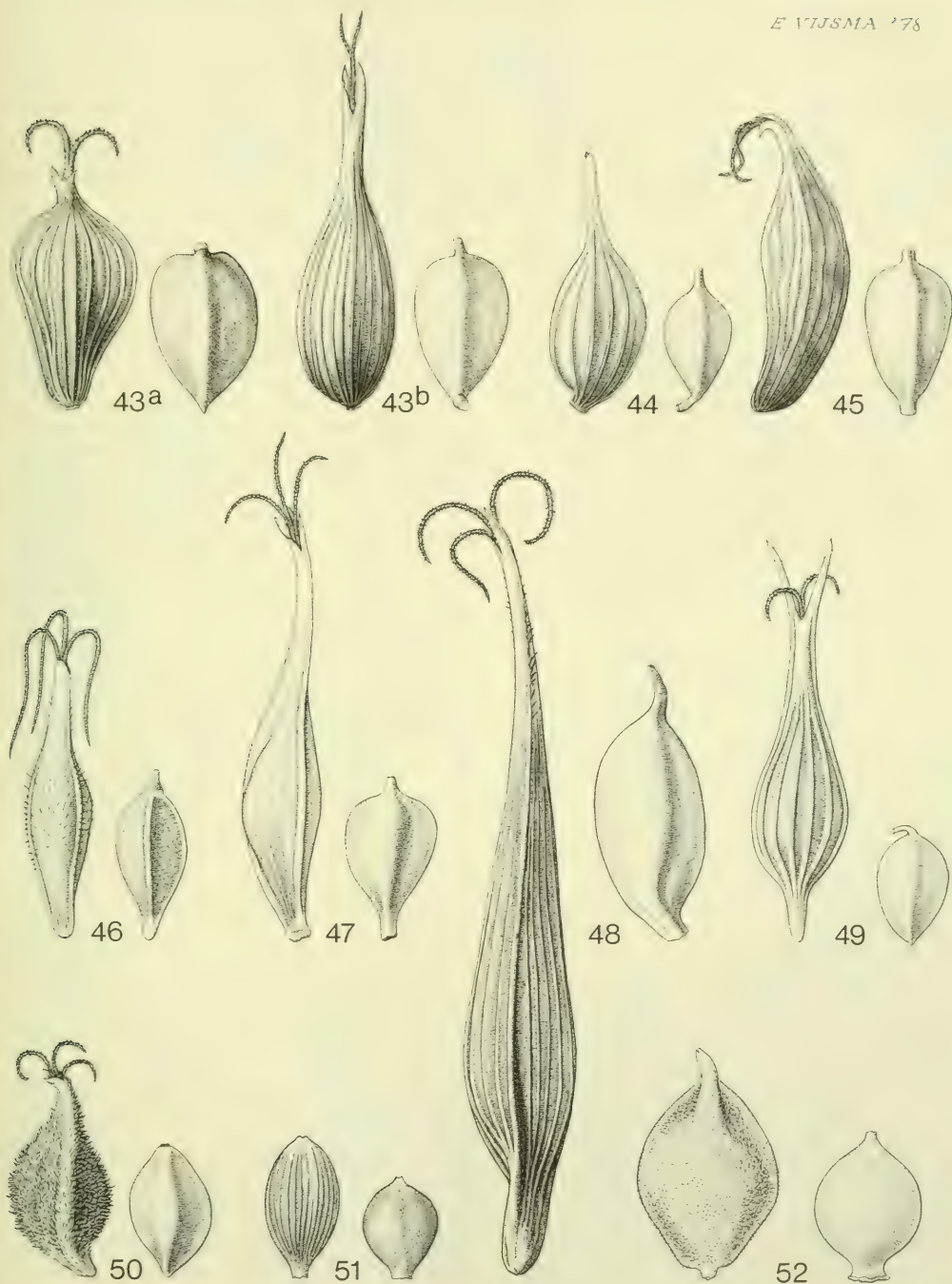


Fig. 122. Utricles and nuts of *Carex*. Species numbered as in the text (43a WOMERSLEY 5122, 43b ANU 614, 44 BRASS 4867, 45 MEIJER 6656, 46 BRASS 9803, 47 LAE 61655, 48 SCHODDE 1992, 49 EYMA 4709, 50 KOSTERMANS 14005, 51 SINCLAIR 9797, 52 JERMY 4634). All  $\times 10$ .

379, incl. var. *diplocolea* NERMES. — *C. rafflesiana* var. *continua* [non (CLARKE) KÜK.] KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 385. — *C. continua* (non CLARKE) S. T. BLAKE, J. Arn. Arb. 28 (1947) 104, p.p. — *C. papuana* NERMES, Kew Bull. (1949) 379; Reinwardtia 1 (1951) 314. — *C. tytholepis* NERMES, Kew Bull. (1949) 388; Reinwardtia 1 (1951) 320. — Fig. 118, 124h-i.

Rhizome short. Stems tufted, rather stout, triquetrous, smooth, 50–100 cm by 3 mm at the base. Leaves subcoriaceous, mostly basal but sometimes one halfway up the stem, shorter than the stems, linear, long-attenuate, with strongly revolute margins, vesiculose-asperous by whitish vesicles especially on the upper surface, (3–)7–10 mm wide; lower sheaths reddish brown, densely but minutely hispidulous, eventually fraying into fibres. Inflorescence a slender, interrupted or subcontinuous, decompound panicle up to 50 cm long; partial panicles 4–12, at up to 8 nodes, mostly single, sometimes binate, oblong-lanceolate, erect, rather dense, 3–9 cm long, upper ones approximate, lower ones distant on slender, rigid, scabrid peduncles more or less exserted from the sheaths; rachis hispid. Lower bracts foliaceous, as long as or longer than the inflorescence, long-sheathing, upper much reduced; bracteoles glumiform, with hispidulous awns. Spikelets numerous, androgynous, oblong or ovoid, 5–12 mm long, the ♂ part shorter than to about as long as the ♀ part. Glumes broadly ovate, often broader than long, obtuse, translucent, glabrous or the lower ones hispidulous, pale fulvous to dark reddish, finely several-nerved, ( $\frac{3}{4}$ –)1–1 $\frac{2}{3}$  mm, the midnerve excurrent into a strong, antorsely scabrid, up to 2 mm long awn. Utricles trigonous, not inflated, ellipsoid or slightly obovoid, membranous, patent, straight or more or less recurved, with (3–)4–6 strong nerves on each face, glabrous and smooth, or hispidulous on the margins in the upper part, subabruptly beaked, light green to stramineous, (2 $\frac{1}{2}$ –)3–4 mm by 1–1 $\frac{1}{4}$  mm; beak slender, compressed, somewhat tapering, straight or slightly curved, scabrid on the margins, shorter than to about as long as the body of the utricle, (1–)1 $\frac{1}{2}$  mm long; mouth bidentate, not or scarcely oblique. Nut ellipsoid or slightly obovoid, triquetrous with shallowly concave sides, brown, 1 $\frac{1}{2}$ –2 by  $\frac{9}{10}$ –1 mm. Style-base slightly thickened. Stigmas 3.

Distr. *Malesia*: throughout New Guinea, also known from some adjacent islands.

Ecol. Primary forests (often *Fagaceae* forests), secondary growths, rarely in wet grassland, 850–2700 m.

Vern. *Anifi*, Wapi lang.

Note. NERMES distinguished *C. papuana* from *C. lamprochlamys* by the narrower leaves and the darker glumes and utricles of the former. To me those differences are insufficient for specific separation. The type collection of *C. tytholepis* I cannot distinguish from *C. lamprochlamys*.

8. *Carex nodiflora* BOECK. Bot. Jahrb. 5 (1884) 516; KÜK. Pfl. R. Heft 38 (1909) 288; Philip. J. Sc. 6 (1911) Bot. 61; MERR. En. Philip. 1 (1923) 140; NERMES, Reinwardtia 1 (1951) 260; *ibid.* 2 (1954) 374. — *C. cumingii* [‘BOOTT’ in VIDAL, Phan. Cuming. (1885) 156; Rev. Pl. Vasc. Filip. (1886) 286, *nomen*]; ex CLARKE, J. Linn. Soc. Bot. 37 (1904) 11; Philip. J. Sc. 2 (1907) Bot. 107. — *C. vulcanica* ELMER, Leaf. Philip. Bot. 10 (1938) 3526. — Fig. 118.

Rhizome shortly creeping, woody, covered with the fibrous remains of old scales. Stems tufted, triquetrous, smooth, surrounded below the leaves by a few bladeless, brown sheaths or their fibrous remains, 50–70 cm by 1 $\frac{1}{4}$ –2 mm. Leaves basal, sometimes 1–2 higher on the stem, much exceeding the stems, rigid, flat, long-attenuate, scabrid on the margins in the upper part, 7–16 mm wide; cauline leaves long-sheathing. Inflorescence a slender, compound panicle, continuous above, interrupted below, 15–35 cm long; secondary panicles 4–6, single at the nodes, erect, spiciform or the middle ones again branched, oblong, dense, 2–6 by 1–2 cm; lower peduncles more or less exserted from the sheaths, smooth, or scabrid above; rachis hispidulous especially above. Lower bracts foliaceous, overtopping the inflorescence, long-sheathing, upper much reduced. Spikelets numerous, androgynous, ovoid, oblong, or subglobose, 5–10 mm long, the ♀ part rather longer than the ♂ part. Glumes ovate-lanceolate, acutish or obtuse, membranous, nerved, shortly setulose above or glabrescent, sparsely ciliate, greenish white or light brown with whitish hyaline margins, 2 mm long, the midnerve excurrent in a smooth or hispidulous,  $\frac{1}{2}$  mm long awnlet. Utricles much overtopping the glumes, trigonous, ellipsoid-rhomboid, with prominent angles and flattish faces, membranous, suberect, many-nerved, straight, whitish setulose (except at the base), scarcely stipitate, rather abruptly beaked, finally dark brown, 3 $\frac{1}{2}$ –4 $\frac{1}{2}$  by 1 $\frac{1}{2}$ –2 mm; beak oblong-conical, bidenticulate, with slightly oblique mouth, 1 mm long. Nut triquetrous, ellipsoid-rhomboid, sessile, narrowly discoid-annulate at the apex, ferruginous to blackish, 2 $\frac{1}{4}$ –2 $\frac{1}{2}$  by 1 $\frac{1}{2}$ –1 $\frac{3}{4}$  mm. Style-base pyramidally thickened, persistent on the nut. Stigmas 3.

Distr. *Malesia*: Philippines (Luzon; according to MERRILL, l.c., also in Alabat and Mindanao: Agusan).

Ecol. Primary forests at low and medium altitudes.

Note. According to NERMES (1951: 262) in this species it is the style-base which is discoid-annulate, not the apex of the nut. I do not see any difference with the nut and style-base of the allied species.

9. *Carex sarawaketensis* KÜK. Bot. Jahrb. 69 (1938) 262; *ibid.* 70 (1940) 464, incl. var. *minor*; NERMES, Reinwardtia 1 (1951) 316. — *C. melano-*



E. VIJSSMA '78

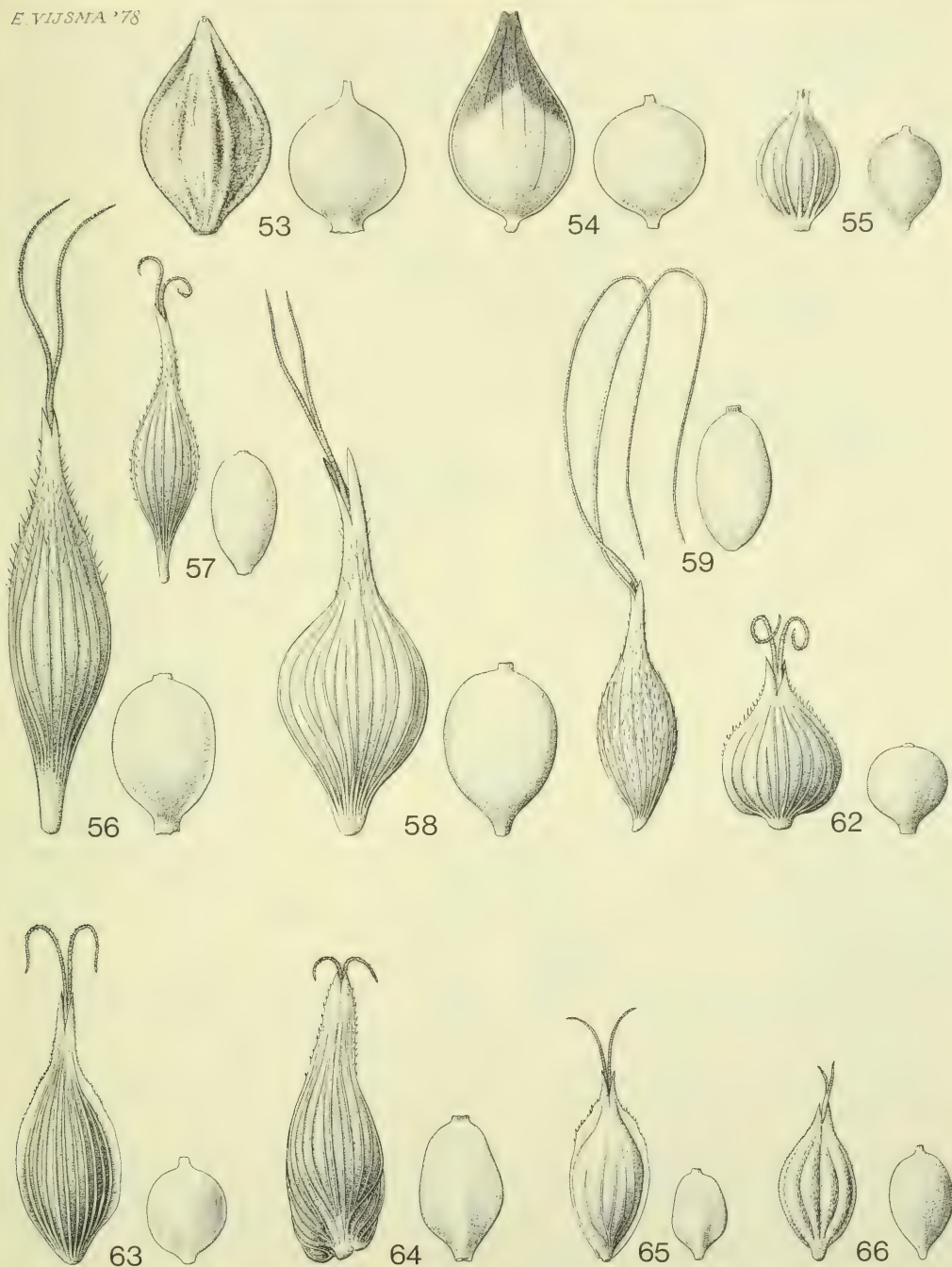


Fig. 123. Utricles and nuts of *Carex*. Species numbered as in the text (53 VAN STEENIS 4624, 54 DE WILDE c.s. 13329, 55 BRASS 9284, 56 BRASS 9515, 57 EYMA 3862, 58 herb. VAN SOEST 88, 59 VAN STEENIS 9804, 62 HOOGLAND & SCHODDE 7470, 63 JESWIET 39, 64 DE WILDE c.s. 13323, 65a KOORDERS 43403, 66 BRASS 9539). All  $\times 10$ .

*phora* S. T. BLAKE, J. Arn. Arb. 28 (1947) 106, f. 2B. — Fig. 118.

Rhizome emitting slender stolons covered with brown or blackish scales. *Stems* erect or somewhat curved, solitary or tufted, slender, obtusely trigonous, smooth or scaberulous at the top, 3–40 (–60) cm by  $1/2$ –1 mm, the base surrounded by the fibrous, reddish-black remains of old leaf-sheaths. *Leaves* basal, rarely 1 higher on the stem, rigid, shorter than the stems, linear, long-attenuate, flat or with revolute margins, conspicuously keeled, scabrid on the margins and keel in the upper part, 2–4 mm wide; lower sheaths fuscous to blackish-purple. *Inflorescence* a decompound, narrow panicle interrupted at the base, 10–20(–30) cm long; partial panicles 3–14, at 2–8 nodes, single and binate, oblong, dense, 1–5 cm long, upper ones approximate, lower on slender, erect, scabrid, up to 8 cm long peduncles exerted from the sheaths. Lower bracts foliaceous, not or scarcely overtopping the inflorescence, long-sheathing, upper ones much reduced; bracteoles glume-like, hispidulous, awned; rachis hispid. *Spikelets* androgynous, suberect or appressed, oblong, 4–10 by 2–2 $1/2$  mm, the ♂ part inconspicuous, mostly shorter than the ♀ part. *Glumes* ovate, membranous, acute, muticous or minutely mucronulate, rarely awned, slenderly nerved, glabrous or the lower ones minutely hispidulous, blackish-fuscous with white-hyaline margins, 2–3 mm long. *Utricles* trigonous, not inflated, ellipsoid, narrowed at both ends, suberect, membranous, straight, obscurely nerved (only 2 nerves more prominent), glabrous at the base, otherwise densely scabrid-pubescent, gradually narrowed into the beak, blackish-fuscous, 2 $3/4$ –4 $1/2$  by  $4/10$ –1 $1/5$  mm; beak straight, compressed, deeply bidentate (teeth  $1/2$ –2 $3/3$  mm) but often originally oblique, scabrid on the margins, 1–1 $3/4$  mm long, the mouth with whitish-hyaline margins. *Nut* triquetrous with shallowly concave sides, ellipsoid or broadly ellipsoid, stipitate, conspicuously apiculate, stramineous-brown, 1 $1/2$ –1 $3/5$  by  $4/5$ –1 mm. *Style* scabrid, not or scarcely incrassate at the base. Stigmas 3.

Distr. *Malesia*: New Guinea (W. New Guinea: Carstensz Mts, Mt Wilhelmina, Hellwig Mts; NE. New Guinea: Mt Sarawaket, Lake Naho).

Ecol. Wet places in alpine grassland, steep mountain slopes, open places in mountain forests, moist grassy cliffs, 2700–3950 m.

10. *Carex stramentitia* BOOTT ex BOECK. Linnaea 40 (1876) 351; CLARKE, Fl. Br. Ind. 6 (1894) 717; J. Linn. Soc. Bot. 37 (1904) 9; KÜK. Pfl. R. Heft 38 (1909) 264; CAMUS, Fl. Gén. I.-C. 7 (1912) 188; NELMES, Kew Bull. (1950) 191; Reinwardtia 1 (1951) 267; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 120; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 45, 99, f. 28 (map); Dansk Bot. Ark. 23 (1965) 254; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 492. — Fig. 118, 124m–n.

Rhizome shortly creeping, stout, woody. *Stems* loosely tufted, trigonous, scaberulous below the nodes to almost smooth, 30–130 cm by  $1\frac{1}{2}$ –3 mm, the base clothed with fuscous, bladeless sheaths and comose by their fibrous remains. *Leaves* subcoriaceous, subbasal and 1–2 higher on the stem, exceeding the stems, linear, long-attenuate, flat or with revolute margins, scabrid on the margins in the upper part, pale green, 5–10(–15) mm wide. *Inflorescence* a pale, compound, erect, much interrupted, narrow, 10–40 cm long panicle; secondary panicles 2–4, single at the nodes, erect, lanceolate or oblong, very dense, distant, up to 10 cm long; peduncles smooth or scaberulous, the lower ones much exerted from the sheaths, the upper ones scarcely so; rachis hispid. Lower bracts foliaceous, exceeding the inflorescence, long-sheathing, hispidulous in front or at the mouth, upper reduced. *Spikelets* androgynous, sessile, suberect, 5–15 mm long, the ♀ part few-flowered, rather shorter than the ♂ part. *Glumes* oblong or oblong-ovate, thinly membranous, obtuse or slightly emarginate, slenderly nerved, glabrous or sparsely hispidulous, not ciliate, pale stramineous to whitish, 2–2 $3/4$  mm long, the midnerve excurrent into an antrorsely scabrid,  $3/4$ –2 mm long awn. *Utricles* distinctly trigonous, rhomboid-ellipsoid, with prominent angles and flattish faces, membranous, not inflated, patulous, many-nerved (nerves 5–7 on each face), glabrous, straight to slightly recurved, curved-tapering below into a cuneate basal part, suddenly narrowed above into the beak, greenish to light brown, 4–5 by c.  $1\frac{1}{2}$  mm; beak straight or slightly curved, often somewhat inflated at the base, glabrous or very sparsely scabrid,  $1\frac{1}{2}$ –2 mm long; mouth dorsally very oblique, not bidentate. *Nut* trigonous, rhomboid-ellipsoid, erostrate, curved-tapering below into a stout cuneate part, with prominent angles and concave faces, brown, 2 $1/4$ –3 by  $1\frac{1}{2}$ –1 $1/5$  mm. *Style-base* pyramidally thickened, persistent on the nut. Stigmas 3.

Distr. India, Lower Burma, S. China (Kweichow), Thailand, Laos, Tonkin, Annam; in *Malesia* only known from a single collection from W. Java (Krawang: Plèrèd near Purwakarta); see map in RAYMOND, 1959, l.c.

Ecol. In Krawang abundant in jungle at low altitude under seasonal climatic conditions.

Vern. *Lilisungan*, S.

Note. In spite of its different facies because of the stiff, linear leaves, *C. stramentitia* is very near *C. commixta*, which it closely resembles in the size and shape of the utricles. According to NELMES the leaves of *C. stramentitia* can reach a width of 20 mm.

11. *Carex vesiculosa* BOOTT, Ill. 3 (1862) 107, t. 323; BOECK. Linnaea 40 (1876) 345; CLARKE, Fl. Br. Ind. 6 (1894) 717, incl. var. *paniculata* CLARKE; KÜK. Pfl. R. Heft 38 (1909) 283, f. 43, incl. var.



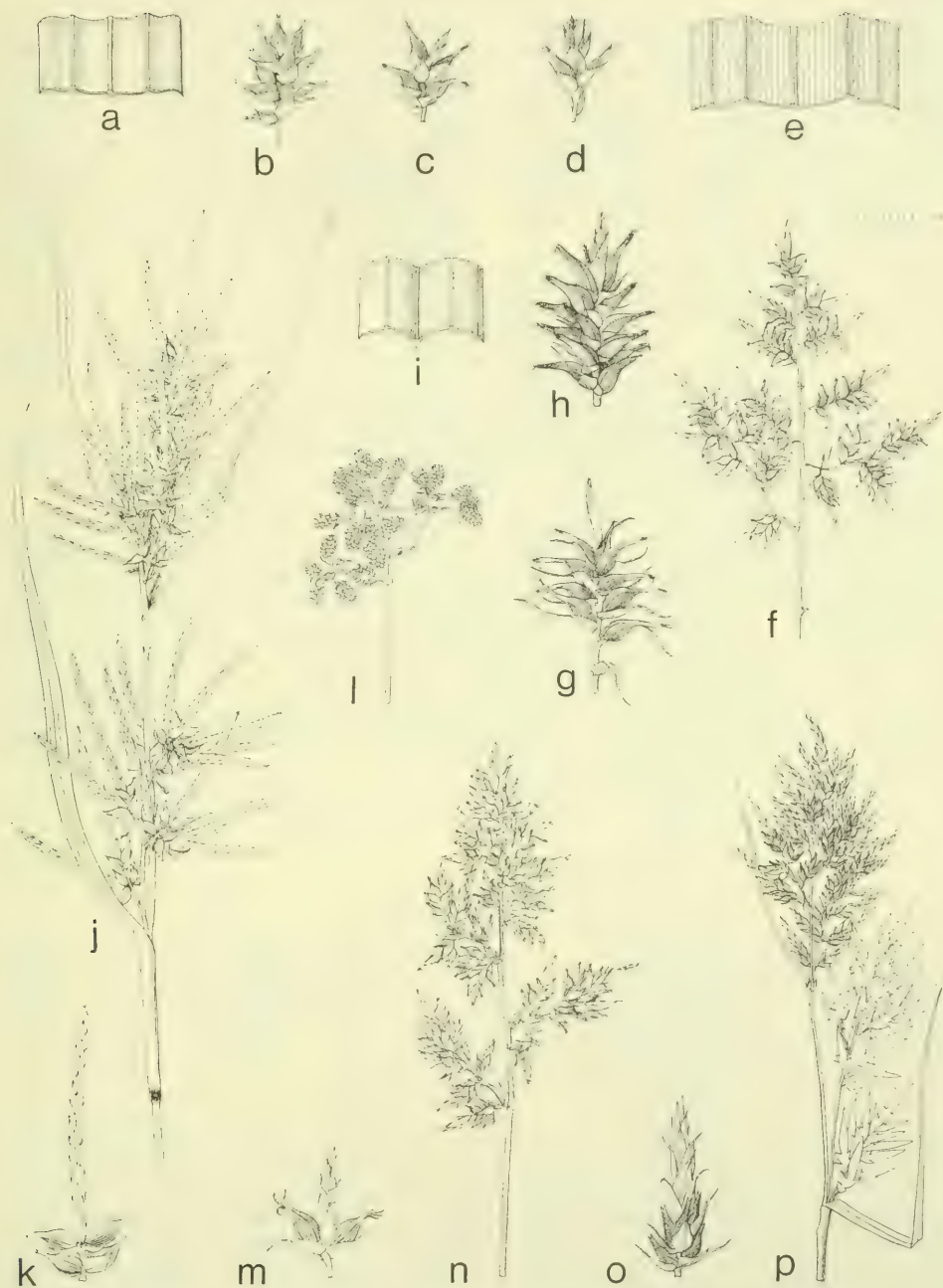


Fig. 124. Inflorescence (nat. size), spikelets and (occasionally) venation ( $\times 2$ ). — 3a. *Carex cruciata* WAHLENB. var. *cruciata*, a-b. — 3b. var. *rafflesiana* (BOOTT) NOOT., c-d. — 5. *C. horsfieldii* BOOTT, e-g. — 7. *C. lamprochlamys* S. T. BLAKE, h-i. — 6. *C. indica* L., j-k. — 13. *C. hypolytroides* RIDL. l. — 10. *C. stramentitia* BOOTT, m-n. — 11. *C. vesiculosa* BOOTT, o-p. (a-b CHEW, CORNER & STANTON 1706, c VAN OOSTSTROOM 13154, d VERHEIJEN 2585, e-g NGF 21261, h-i BRASS 24684, j-k RIDLEY 15721, l BÜNNEMEIJER 9820, m-n BAKHUIZEN VAN DEN BRINK 6565, o-p VAN STEENIS 4140).

*congesta* KÜK.; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 68; KERN in BACK. & BAKH. f. Fl. Java 3 (1968) 492. — *C. impunctata* BOOTT, Ill. 3 (1862) 107, t. 326 (pl. *depauperata*); BOECK. Linnaea 40 (1876) 342. — *C. gembolensis* CLARKE, J. Linn. Soc. Bot. 37 (1904) 10; NELMES, Reinwardtia 1 (1951) 374, incl. var. *crebra* NELMES; *ibid.* 2 (1954) 376. — *C. rhizomatosa* var. *impunctata* KÜK. Pfl. R. Heft 38 (1909) 291. — *C. vesiculosa* var. *latifolia* KÜK. in Hochr. Candollea 6 (1931) 341. — Fig. 118, 124a–p.

Rhizome shortly creeping, woody, covered with the fibrous remains of decayed sheaths. *Stems* loosely tufted, stiff, trigonous, smooth, 30–150 cm by 2–3 mm, surrounded below the leaves by bladeless, reddish or fuscous sheaths and their fibrous, often reticulate remains. *Leaves* coriaceous, basal and 1–2 higher on the stem, usually much shorter than the stems, narrow, long-attenuate, keeled, with strongly revolute margins when dry, scabrous on the margins, often vesiculose-asperous above especially towards the apex, 2–8 mm wide. *Inflorescence* a decompound, interrupted, ferrugineous, 15–40 cm long panicle; secondary panicles 5–10, at 4–6 nodes, lowest 1–2 often single, remainder usually unequally binate, erect, often with nodding top, oblong-pyramidal, dense or very dense, rarely loose, up to 10 by 5 cm, upper ones approximate, lower distant on exerted, smooth or scabrid, up to 15 cm long peduncles; rachis hispidulous on the angles. Lower bracts foliaceous, narrow, shorter than the inflorescence, long-sheathing, the upper ones much reduced; bracteoles pilose, excurrent in a curved, hispidulous awn. *Spikelets* numerous, androgynous, obliquely patent, 5–

15 mm long, the ♂ part in the longer spikelets much longer than the few-flowered ♀ part. *Glumes* lanceolate-ovate, acutish, sometimes lightly emarginate, membranous, translucent, glabrous or somewhat hispidulous, ferrugineous or castaneous, 2<sup>1</sup>/<sub>2</sub>–4<sup>1</sup>/<sub>2</sub> mm long, the midnerve in the upper glumes excurrent in a hispid, up to 1<sup>3</sup>/<sub>4</sub> mm long awn. *Utricles* triquetrous, narrowly ellipsoid, subcoriaceous, not inflated, obliquely erect, straight or but slightly recurved, slenderly or obscurely nerved, rather densely setulose in the upper <sup>3</sup>/<sub>4</sub>, scarcely stipitate, rather abruptly beaked, reddish with castaneous flecks, 3–5 by 1–1<sup>3</sup>/<sub>4</sub> mm; beak slender, scabrid on the margins, mouth not oblique, 1<sup>1</sup>/<sub>4</sub>–2 mm long. *Nut* triquetrous, ellipsoid or slightly obovoid, with concave faces, shortly stipitate, abruptly beaked, 1<sup>1</sup>/<sub>2</sub>–2<sup>1</sup>/<sub>2</sub> by 1–1<sup>1</sup>/<sub>2</sub> mm. *Style-base* scarcely thickened. Stigmas 3.

Distr. Nepal to Thailand; in *Malesia*: Java (in W. Java on Mt Papandajan, not rare in the mountains of Central and E. Java), Lesser Sunda Is. (Bali, Lombok, Flores, Timor).

Ecol. In dry grass-lands, open stony places, mountain scrub, *Casuarina* forests, 1200–3500 m.

Notes. In old specimens the leaves are often less asperous because the vesiculose (bulbous-based) hairs have broken off. The former presence of vesicles is indicated by small, circular scars.

If *C. gembolensis* is specifically distinct from *C. vesiculosa*, its correct name is *C. impunctata* BOOTT, based on ZOLLINGER 2563 from Java. This collection NELMES rightly included in *C. gembolensis*.

Var. *congesta* KÜK. (= *C. gembolensis* var. *crebra* NELMES) has no taxonomic value.

## 2. Section Japonicae

KÜK. Pfl. R. Heft 38 (1909) 252. — *Sect. Paciricae* OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 458; NELMES, Reinwardtia 1 (1951) 329; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 52. — *Sect. Indicae subsect. Japonicae* (KÜK.) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 152.

Type species: *Carex nikoensis* FRANCH. & SAVAT.

12. *Carex satzumensis* FRANCH. & SAVAT. En. Pl. Jap. 2 [(1877) 132, *nomen*] (1878) 558; FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris III, 8 (1896) 259 (t. 4, f. 1 ut *C. nikoensis*); AKIYAMA, J. Fac. Sc. Hokk. Imp. Un. V, 2 (1932) 84, f. 36; CAR. Far East. Reg. Asia (1955) 135, t. 121; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 458; NELMES, Reinwardtia 1 (1951) 330; KOYAMA, Nat. Canad. 82 (1955) 197; Contr. Inst. Bot. Un. Montréal n. 70 (1957) 10; YOSHIKAWA, Ic. Jap. Carex 2 (1958) 236, t. 118; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 52. — *C. nikoensis* FRANCH. & SAVAT. En. Pl. Jap. 2 [(1877) 132, *nomen*] (1878)

558; KÜK. Pfl. R. Heft 38 (1909) 252, f. 38A–E ('*nikkoensis*'); Philip. J. Sc. 6 (1911) Bot. 59; MERR. En. Philip. 1 (1923) 140. — *C. contracta* BOECK. Cyp. Nov. 2 (1890) 34. — Fig. 119.

Rhizome long-creeping, clothed with large, brown scales. *Stems* erect, triquetrous, ribbed, smooth, or scabrid just below the inflorescence, 3–20(–30) cm by 1–1<sup>1</sup>/<sub>2</sub> mm, surrounded at the base by the fibrous remains of old leaf-sheaths. *Leaves* subbasal, rigid, flattish to conduplicate, longer than the stems, often recurved, scabrid on the margins and on the upper surface towards the long-attenuate apex, 2–5 mm wide. *Inflorescence*





Fig. 125. *Carex indica* L. a. Habit,  $\times \frac{4}{3}$ , b-c. glumes, d. fruit in utricle, e. fruit, all  $\times 7$  (SCHODDE 2972).

simple, spiciform, sometimes slightly branched at the base, cylindrical-conical, acute, 2–8 cm by 1–2½ cm at the base; rachis smooth. Lower bracts subulate to subfoliaceous, shorter than the inflorescence, not sheathing, upper filiform. *Spikelets* 12-numerous, androgynous, sessile, patent, ovate to oblong, densely flowered, lower 5–14 mm, upper 3–7 mm long, all the lateral ones

arising from a  $\pm$  utriculiform, gibbous prophyll containing a  $\varnothing$  flower. *Glumes* lanceolate-ovate, acute to obtuse, glabrous, pale, slenderly nerved, 2–3 mm long, the midrib sometimes slightly excurrent. *Utricles* oblong-ellipsoid, obtusely trigonous, hardly inflated, glabrous, slenderly plurinerved, greenish, 2½–3½ by ¾–1 mm, rather gradually narrowed into a long, conical, bilobed beak with

oblique mouth. *Nut* oblong-obovoid, triquetrous, shortly beaked, dark brown,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm long. *Style* pyramidally thickened at the base. Stigmas 3.

Distr. Japan, Formosa, Tonkin; in *Malesia*: Philippines (Luzon: Benguet).

Ecol. Along trails in the mossy forest, at c. 2300 m, also along roadsides under pine-trees at 400 m.

Notes. Readily recognizable by its spike-like inflorescence with non-sheathing bracts.

*Carex nikoensis* FRANCH. & SAVAT., with slightly larger spikelets in denser spikes and somewhat

longer beak of the utricle than in typical *C. satzumensis*, was already reduced to *C. satzumensis* by FRANCHET (1896).

The specific epithet is frequently spelt '*satsumensis*', but the spelling '*satzumensis*', employed when the species was validly published, must be retained.

In an abnormal inflorescence of SANTOS 5776 from Luzon I found in all branches between the fertile cladophrophyll and the normal utricles some deeply split utricles containing one or some ♂ flowers besides the ♀ one, a situation normal in *Schoenoxiphium* and *Kobresia*.

### 3. Section Hypolytroides

NELMES, Kew Bull. (1951) 121; Reinwardtia 1 (1951) 246; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 21.

Type species: *Carex hypolytroides* RIDL.

13. *Carex hypolytroides* RIDL. J. Fed. Mal. St. Mus. 8 (1917) 124; NELMES, Reinwardtia 1 (1951) 246; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 96; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 21, f. 3, 102, f. 31 (map). — *C. hypolytroides* GROSS & MATTF. Notizbl. Berl.-Dahl. 14 (1938) 190. — *C. hypolytropis* GROSS in Fedde, Rep. 50 (1941) 213. — Fig. 119, 124l, 126.

Rhizome woody, emitting strong stolons covered with lanceolate, fuscous sheaths. *Stems* rigid, erect, rather acutely trigonous, smooth, 100–250 cm by 3–5 mm, surrounded at the base by a few reddish brown, bladeless sheaths. Leaves at regular intervals throughout the stem, shorter than the stem, stiff, flattish, or with revolute margins when dry, smooth, or scabrid on the margins, sparsely to rather densely covered with long, pale hairs beneath, 4–8 mm wide; sheaths smooth, hairy above, membranous in front, with concave mouth; ligule elongate, hairy, ferrugineous. *Inflorescence* a compound, interrupted panicle, 25–40 cm long; secondary panicles 5–8, erect, broadly pyramidal, single at the nodes, or lowest sometimes binate, rather loose, upper approximate, lower distant, on exserted, hispidulous peduncles with patent branches. Lower bracts foliaceous, slightly exceeding the inflorescence, long-sheathing, upper reduced. *Spikelets* usually unisexual; ♀ ones numerous, shortly cylindrical, very dense, 5–8 by  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm, sometimes with a few ♂ flowers at the top; ♂ ones inconspicuous, few, lateral, 1–5 just below some of the terminal ♀ spikelets, sessile, ellipsoid, 4 by 1–2 mm. Cladophrophylls of branches and peduncles utriculiform, hairy, those of the ♂ spikelets sometimes enclosing a ♀ flower, those of the partial panicles ocreiform. *Glumes* thinly membranous, ovate-lanceolate, acute, hairy, slenderly nerved, with narrow whitish-hyaline margins

and shortly excurrent midnerve, 2– $2\frac{3}{4}$  mm long, in ripe spikelets almost completely hidden among the utricles. *Utricles* obtusely trigonous, obovoid, not or but slightly inflated, horizontally patent, straight, glabrous or very sparsely hispidulous, slenderly nerved (2 nerves more prominent), fuscous, densely reddish glandular-spotted,  $1\frac{1}{4}$ – $1\frac{2}{3}$  by c. 1 mm, subabruptly narrowed into a very short, bidenticulate beak. *Nut* triquetrous, obovoid, filling the utricle, sessile, brown, whitish papillose,  $1\frac{1}{5}$ – $1\frac{1}{3}$  by  $\frac{9}{10}$ –1 mm. *Style-base* thickened. Stigmas 3.

Distr. Tonkin, Annam; in *Malesia*: Central Sumatra (Mt Kerintji), Borneo (Mt Kinabalu: Lumu-lumu, Mesilau Cave). See the distribution map by RAYMOND, l.c.

Ecol. In wet spots in forests, on Mt Kerintji between 2200 and 2750 m, on Mt Kinabalu at 1800 m.

Notes. The infructescence so strongly recalls a *Hypolytrum* that RIDLEY and GROSS independently of each other chose the epithet *hypolytroides* for it.

The ♂ spikelets are inserted laterally, as they are borne from a utriculiform prophyll, and therefore cannot have degraded from an originally terminal position as was supposed by NELMES, Reinwardtia 1 (1951) 248.

*Carex hypolytroides* is closely related to *C. moupinensis* FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris II, 10 (1888) 102; *ibid.* III, 8 (1896) 257, t. 7 f. 2; CLARKE, J. Linn. Soc. Bot. 36 (1904) 209; KÜK. Pfl. R. Heft 38 (1909) 289; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 21, f. 2. — *Homalostachys sinensis* BOECK. Cyp. Nov. 1 (1888) 38, non *C. chinensis* RETZ. — *Scleria sinensis* H. PFEIFF. in Fedde, Rep. 26 (1929) 263, only known from China (Hupeh, Szechuan, Yunnan).





Fig. 126. *Carex hypolytroides* RIDL. a. Habit,  $\times \frac{4}{3}$ , b. terminal ♀ and lateral ♂ spikelet,  $\times 3$ , c-d. fruit in utricle, e. fruit, both  $\times 13$  (JACOBS 4332).

The latter species is much lower, with narrower leaves, and usually all the spikelets of the terminal partial panicle ♂; it is especially characterised by

the slightly larger (2 by  $1\frac{1}{3}$  mm), much inflated utricles truncate or depressed at the top, and the nut not filling the utricle.

4. Section *Mapaniifoliae*

NELMES & AIRY SHAW in Hook. Ic. Pl. 35 (1943) t. 3434; NELMES, *Reinwardtia* 1 (1951) 248; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 27; 93, f. 23 (map). — *Sect. Indicae subsect. Scaposae* KÜK. Pfl. R. Heft 38 (1909) 285, p.p.

Type species: *Carex helferi* BOECK.

14. *Carex helferi* BOECK. Linnaea 40 (1876) 365; CLARKE, Fl. Br. Ind. 6 (1894) 714; KÜK. Pfl. R. Heft 38 (1909) 286; NELMES in Hook. Ic. Pl. (1947) t. 3468; Kew Bull. (1950) 189; *Reinwardtia* 1 (1951) 248; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 99; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 30; Dansk Bot. Ark. 23 (1965) 252; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 491. — *C. mapaniifolia* RIDL. J. Fed. Mal. St. Mus. 10 (1920) 124; NELMES, Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 98; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 30. — Fig. 119.

Rhizome short, stout, woody, clothed with some brown bladeless sheaths or their fibrous remains. Stems central, erect, scapiform, trigonous or subterete, smooth, or scabrid on the angles, (5–)20–40 cm by 1–2 mm, the base enveloped by some brown, infundibuliform, up to 10 cm long sheaths. Leaves overtopping the stems, broadly linear, conduplicate below (narrowed into a pseudopetiole), otherwise flat, long-acuminate, minutely scabrid on the margins in the upper part, with the midnerve and 2 mid-lateral nerves prominent,  $1\frac{1}{2}$ – $3\frac{1}{2}$  cm wide; ligule elongate-triangular, brown-bordered,  $1\frac{1}{2}$ –2 cm long. Inflorescence paniculate, consisting of (2–)3–7 partial inflorescences, up to 25 cm long; partial inflorescences erect, oblong-ovoid, very dense, head-like, upper approximate, lower distant, single at the nodes, with hispid rachis, 2– $3\frac{1}{2}$  by 1– $2\frac{1}{2}$  cm, on exserted, smooth or finely scabrid peduncles. Bracts sheath-like, amplate, infundibuliform, short-bladed, light brown or spadiceous. Spikelets densely crowded, androgynous, ovoid, patent, 6–10 by 5–8 mm, the ♂ part usually much longer than the few-flowered ♀ part. Glumes thinly membranous, oblong-ovate, obtuse to truncate-bilobed, many-

nerved, glabrous or hispidulous, pale brown with broad, whitish hyaline margins, 2–4 mm long, the midnerve excurrent in a 1–4 mm long, scabrous, often recurved awn. Utricles trigonous, ellipsoid, with shallowly concave faces, patulous, glabrous at the base, hispidulous above, shortly stipitate, strongly 6–8-nerved on each face, stramineous to brown, 6–7 by  $1\frac{1}{2}$ – $1\frac{1}{5}$  mm (the long beak included); beak hispidulous, curved, bulbous at the base (to hold thickened style-base), nearly linear above, with very oblique mouth (its base  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm from the apex), 3– $3\frac{1}{2}$  mm long. Nut trigonous, ellipsoid or slightly obovoid, scarcely stipitate, shortly beaked and suddenly expanded into the conical style-base, dark brown with pale angles,  $2\frac{1}{2}$ – $2\frac{3}{4}$  by  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm. Style-base pyramidally thickened, subpersistent on the nut. Stigmas 3.

Distr. Lower Burma, SE. & Peninsular Thailand; in *Malesia*: W. Java (Priangan). Wrongly recorded for Sumatra and Borneo by NELMES (1950, p. 100).

Ecol. In forests, 1100 m.

Notes. This is the only Malesian member of the wide-leaved *sect. Mapaniifoliae*, which section appears to be almost confined to the Indo-Chinese Peninsula, where it is represented by several species.

The few Javan specimens hitherto collected are vegetatively much less developed than those from the continent, but agree with them in floral and fruit characters.

By its broad leaves, scapiform flowering stems, and shape of the inflorescence *Carex helferi* deceptively resembles *Hypolytrum humile* (STEUD.) BOECK. It can be distinguished by the long-beaked utricles, the 3 stigmas, and the trigonous nuts.

5. Section *Polystachyae*

[TUCKERM. En. Meth. (1843) 10, *nomen* ('*Polystachae*')]; ex KÜK. Bot. Jahrb. 27 (1899) 517, *quoad basion.*; Pfl. R. Heft 38 (1909) 257; NELMES, *Reinwardtia* 1 (1951) 322; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 49. — *Sect. Acrarrhenae* FRIES *Sippe Longebracteatae* PAX in E. & P. Nat. Pfl. Fam. 2, 2 (1887) 124. — *Sect. Polystachyae* CLARKE [ser.] *Longispicae* CLARKE, J. Linn. Soc. Bot. 37 (1904) 4, p.p. — *Sect. Extensae* FRIES *subsect. Baccantes* KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 151.

Type species: *Carex myosurus* NEES.



15. *Carex baccans* NEES in Wight, Contr. Bot. Ind. (1834) 122; KUNTH, En. 2 (1837) 513; BOOTT, Ill. 2 (1860) 83, t. 234–236, 238, 239; BOECK. Linnaea 40 (1876) 339; O. K. Rev. Gen. Pl. 2 (1891) 747, incl. var. *nigra* O. K.; CLARKE, Bot. Mag. III, 49 (1893) t. 7288; Fl. Br. Ind. 6 (1894) 722; J. Linn. Soc. Bot. 37 (1904) 14, incl. var. *siccifructus* CLARKE; Philip. J. Sc. 2 (1907) Bot. 108; KÜK. Pfl. R. Heft 38 (1909) 258, f. 39E–H; Philip. J. Sc. 6 (1911) Bot. 59; KOORD. Exk. Fl. Java 1 (1911) 211; CAMUS, Fl. Gén. I.-C. 7 (1912) 185; MERR. En. Philip. 1 (1923) 136; RIDL. Fl. Mal. Pen. 5 (1925) 184; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 462; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 68; NELMES, Kew Bull. (1950) 194; Reinwardtia 1 (1951) 322; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 50; KOYAMA, J. Fac. Sc. Tokyo Un. III, 8 (1962) 216; Dansk Bot. Ark. 23 (1965) 257; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 493; STEEN. Mt. Fl. Java (1972) pl. 15–1. — *C. curvirostris* KUNZE, Suppl. Riedgr. (1840–50) 79, t. 20; MIQ. Fl. Ind. Bat. 3 (1856) 350; CLARKE, J. Linn. Soc. Bot. 37 (1904) 14; STEUD. [in Zoll. Syst. Verz. 1 (1854) 60, nomen] Syn. 2 (1855) 207 ('*recurvirostra*'). — *C. javanica* BOECK. Cyp. Not. 1

(1888) 43. — *C. walkeri* (non ARN. ex BOOTT) KÜK. Pfl. R. Heft 38 (1909) 546; cf. BACK. Brittonia 3 (1938) 76. — Fig. 119, 127, 131i.

Rhizome short, stout, woody. Stems usually robust, loosely tufted, erect, triquetrous or trigonous, smooth, 60–150 cm by up to 5 mm, the base surrounded by reddish, bladeless sheaths splitting in front into reticulate fibres. Leaves all over the stem, often overtopping the inflorescence, long-attenuate, coriaceous, flat or with revolute margins, asperous on the upper surface in the apical part, with scabrous margins, 5–18 mm wide; sheaths long, often splitting up in front. Inflorescence paniculate, compound or decompound, oblong, occupying  $\frac{1}{3}$ – $\frac{1}{2}$  of the stem, erect or somewhat nodding at the top; partial panicles 5–8, single at the nodes, much branched, upper approximate, lower distant on long-exserted, smooth or scabrid peduncles. Lower bracts usually much overtopping the inflorescence, foliaceous, long-sheathing, upper much reduced. Spikelets very numerous, androgynous, suberect to patent,  $2\frac{1}{2}$ –8 cm long; ♀ part cylindrical, densely flowered, usually longer than the slenderer ♂ part. Glumes ovate or oblong-ovate, acute to subobtusate, glab-



Fig. 127. *Carex baccans* NEES in pioneer tufts with sand-binding capacity in the sand plain and dunes of volcanic ash of the Tengger Sandsea, East Java, c. 1900 m altitude (CLASON).

rous or hispidulous, strongly nerved, purplish or castaneous with whitish-hyaline margins, mucous or the midrib excurrent in a scabrid mucro,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long. *Utricles* inflated, obscurely trigonous, obovoid to subglobose, patent, subcoriaceous, strongly nerved, glabrous except for the hispidulous margins at the apex, shining, at first yellowish green, ultimately red and more or less succulent,  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm long, abruptly beaked; beak recurved, bidentate. *Nut* triquetrous, ellipsoid, with flattish or shallowly concave faces, dark brown,  $2\frac{3}{4}$ –3 mm long. *Style-base* not thickened. Stigmas 3.

Distr. Ceylon, India (Sikkim and Khasia), S. China and Formosa, and through Thailand and Indo-China to Malesia; in *Malesia*: Sumatra, Malay Peninsula (Pahang), Java, Lesser Sunda Is. (Bali, Lombok), Philippines (Luzon), New Guinea.

Ecol. In damp thickets, open places in forests, in the mossy forest on the higher mountains, sometimes in mountain savannahs, or as pioneer in the Sandsea and on fresh landslides, on volcanoes, talus; (600–)1000–3300 m.

Vern. *Ladingan, ria-ria-batu, sukēt kērisan, J, ilat beureum, ilateun tēki*, S; Philip.: *gihidsan*, Bon., *mankat, silak*, Ig.; New Guinea: *djugudjugufa*, Dunantina, *djugudjuguha*, Asoro: Kefamo, *pul*, Chimbu: Masue, *koimin*, Wahgi: Minj.

Note. This beautiful species seems to be sometimes cultivated as an ornamental in temperate regions; see NICHOLSON, Ill. Dict. Gard. 1 (1885–89) 267, f. 367).

16. *Carex myosurus* NEES in Wight, Contr. Bot. Ind. (1834) 122; KUNTH, En. 2 (1837) 507; STEUD. Syn. 2 (1855) 207; BOOTT, Ill. 2 (1860) 82, t. 229, 230, 232; BOECK. Linnaea 40 (1876) 334; CLARKE, Fl. Br. Ind. 6 (1894) 723, incl. var. *eminens* (NEES) CLARKE; KÜK. Pfl. R. Heft 38 (1909) 258; MERR. En. Philip. 1 (1923) 139; NELMES, Kew Bull. (1950) 195, incl. var. *celebica* NELMES; Reinwardtia 1 (1951) 325; *ibid.* 2 (1954) 377; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 51; KERN in BACK. & BAKH. f. Fl. Java 3 (1968) 493; STEEN. Mt. Fl. Java (1972) pl. 14–2. — *C. eminens* NEES in Wight, Contr. Bot. Ind. (1834) 122. — *C. longibracteata* STEUD. [in Zoll. Syst. Verz. 1 (1854) 60, *nomen*] Syn. 2 (1855) 205 ('*longibracteata*'), non SCHLEICH. Cat. Pl. Helv. ed. 4 (1821) 11, *nomen*; MIQ. Fl. Ind. Bat. 3 (1856) 348, incl. var. *major* MIQ.; BOECK. Linnaea 39 (1875) 108; CLARKE, J. Linn. Soc. Bot. 37 (1904) 15; KÜK. Pfl. R. Heft 38 (1909) 260, incl. f. *distans* KÜK. et f. *angustifolia* KÜK.; Bull. Jard. Bot. Btzig III, 16 (1940) 314, incl. var. *gigantea* KÜK.; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 70; NELMES, Reinwardtia 1 (1951) 327; *ibid.* 2 (1954) 377. — *C. floribunda* BOECK. Linnaea 40 (1876) 335. — *C. kuntzeana* BOECK. Cyp. Nov. 1 (1888) 51. — *C. composita* (non BOOTT) CLARKE, J. Linn. Soc. Bot. 37 (1904) 14. — Fig. 119.

Rhizome short, stout, woody. *Stems* slender,

loosely tufted, erect, trigonous, smooth, (20–)50–150 cm by up to 4 mm at the base, clothed at the base with fuscous to purplish sheaths or their fibrous, reticulate remains. *Leaves* mainly subbasal, a few widely spaced on the stem, equalling or exceeding the inflorescence, long-attenuate, coriaceous, flat or with revolute margins, asperous on the upper surface in the upper part, with scabrous margins, (2–)5–10 mm wide; sheaths long, often reddish, frayed in front into reticulate fibres. *Inflorescence* from almost simple to decomposed, narrow, (10–)25–100 cm long, erect or somewhat nodding at the top; secondary panicles 5–9, single at the nodes, upper approximate, lower distant on exserted, more or less scabrid peduncles, sometimes all reduced to simple spikelets. Lower bracts foliaceous, long-sheathing, exceeding the stem, upper much reduced. *Spikelets* androgynous, suberect to patulous, the longer ones on a plant 3 to 10 cm long, ♂ and ♀ parts often about equal in length, but sometimes the terminal spikelet almost wholly ♂ and some of the lateral almost wholly ♀. *Glumes* oblong or oblong-ovate, acute to obtuse, glabrous, or sparsely hispidulous, slenderly nerved, pale to castaneous, with whitish-hyaline margins,  $2\frac{1}{2}$ –4 mm long, the midrib usually excurrent in a hispidulous awn up to 2 (rarely 3) mm long. *Utricles* trigonous, ellipsoid or ellipsoid-obovoid, patulous, membranous, slenderly nerved, sparsely to subdensely hispidulous at least towards the apex, straight or slightly bent, pale to castaneous,  $3$ – $4\frac{1}{2}$  mm long, subgradually to subabruptly narrowed into a hispidulous-margined, bidentate,  $\frac{3}{4}$ –1 mm long beak. *Nut* triquetrous, ellipsoid, oblong-ellipsoid, or slightly obovoid, with flattish to slightly concave sides, dark brown, abruptly beaked, 2–3 mm long; stipe and beak straight to bent at the base. *Style-base* not thickened. Stigmas 3.

Distr. India, Burma, Indo-China; in *Malesia*: Sumatra (Atjeh, W. Coast Res.), Java, Lesser Sunda Is. (Lombok: Mt Rindjani), Philippines (Luzon: Bontoc), SW. Celebes (Mt Bonthain).

Ecol. In open or lightly shaded places, on forested slopes, in mountain scrub, heath formations, a pioneer on sterile crater soil, sometimes dominant; 1700–3300 m.

Notes. *Carex myosurus* in the wide circumscription here accepted is extremely polymorphous. CLARKE, Fl. Br. Ind. 6 (1894) 723, distinguished between typical *C. myosurus* (from Nilghiri Mts and Coromandel) and *C. myosurus* var. *eminens* (NEES) CLARKE (occurring throughout the Himalayas), the latter mainly characterized by the shorter and usually broader utricles with often rather deeply bifid beak, although in some Sikkim and Bhotan plants (distinguished by BOECKLER as *C. floribunda*) the beak is not more notched than in the Nilghiri plants. *Carex spiculata* BOOTT, with narrower leaves, denser spikelets with obliquely ascending utricles and more rigid panicles he



considered specifically distinct. Obviously he had not seen Malesian specimens of *C. longibracteata* STEUD. (cf. J. Linn. Soc. Bot. 37, 1904, 15).

KÜKENTHAL, Pfl. R. Heft 38 (1909) 259, distinguished *var. eminens* by the shorter and broader utricles and the usually fuscous glumes, and *var. floribunda* (BOECK.) KÜK. by its profusely branched inflorescences; *C. spiculata* was reduced to sub-specific rank. On the other hand, *C. longibracteata* was upheld as a species. As in numerous Indian *myosurus* specimens the inflorescence is paniculate or even spicate (see KÜKENTHAL's description!) it is clear that *C. longibracteata* must be separated from *C. myosurus* on account of the characters used in KÜKENTHAL's key ("inflorescentia subdepaniculata, spiculae numerosae" in *C. myosurus*, versus "inflorescentia paniculata rarius spicata, spiculae haud numerosae" in *C. longibracteata*).

No more can I understand in what way NELMES

distinguished between *C. myosurus* and *C. longibracteata*, for the former is said to have leaves 5–10 mm wide and secondary panicles composed of 3 to rather numerous spikelets, whereas the latter should differ in having leaves 2–6 mm wide and secondary panicles composed of 1–7 spikelets. Besides, in the Lombok specimens referred to *C. myosurus*, the leaves are only 2–3 mm wide.

*Carex longibracteata* is very similar to *C. myosurus* *var. eminens*; usually the inflorescence is less compound (but profusely branched inflorescences occur, see KERN 8376!) and the utricles are still somewhat broader. In the Celebes and Lombok specimens referred by NELMES to *C. myosurus* the utricles are considerably narrower.

The only Javan collection NELMES referred to *C. myosurus* (VAN STEENIS 12267) was gathered together with VAN STEENIS 12269, which was named *C. longibracteata* for reasons I do not understand.

## 6. Section Oligostachyae

CLARKE, J. Linn. Soc. Bot. 37 (1904) 4. — *Sect. Polystachyae* CLARKE [ser.] *Longispicae* CLARKE, l.c., p.p. — *Sect. Frigidae* FRIES subsect. *Decorae* KÜK. Pfl. R. Heft 38 (1909) 541. — *Sect. Decorae* (KÜK.) OHWI, Mém. Coll. Sc. Kyoto Imp. Un. B11 (1936) 338; NELMES, Reinwardtia 1 (1951) 332; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 54, 71; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 154. — *Sect. Borneenses* NELMES, Kew Bull. (1951) 121; Reinwardtia 1 (1951) 347; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 54, 82.

Type species: *Carex borneensis* CLARKE (lectotype).

17. *Carex celebica* KÜK. Bot. Jahrb. 70 (Jan. 1940) 465; Bull. Jard. Bot. Btzg III, 16 (Feb. 1940) 318; NELMES, Kew Bull. (1949) 389; Reinwardtia 1 (1951) 345. — *C. constricta* S. T. BLAKE, J. Arn. Arb. 28 (1947) 112, f. 4A. — Fig. 119.

Rhizome creeping, emitting slender stolons. *Stems* solitary or somewhat tufted, erect or curved, triquetrous, smooth, often hidden in the leaf-sheaths, 2–25 cm by c. 1½ mm, surrounded below the leaves by purplish cataphylls or their fibrous remains. *Leaves* subbasal, often recurved, longer than the stem, flattish or canaliculate, rigid, scabrid in the upper part, gradually attenuate into a firm point, 1½–5 mm wide; sheath purplish. *Inflorescence* consisting of 5–15 spikelets, 2–10 cm long. Lower bracts foliaceous, much exceeding the inflorescence, shortly sheathing, upper much reduced. *Spikelets* suberect, ½–3 cm long, upper approximate on hardly or not exerted; smooth peduncles; lower sometimes distant on longer peduncles, terminal ♂, linear, 1–2 mm thick, lateral ♀ or with a few ♂ flowers at the top, cylindric, 3–4 mm thick, lowest solitary, upper in fascicles of 2–3 (at least one of the fascicles of 3). *Glumes* ovate or oblong-ovate, obtuse to emarginate, more

rarely acute, reddish brown with whitish-hyaline margins, slenderly few-nerved, 2–3 mm long, the midrib excurrent in a mucro or in an up to 3 mm long awn. *Utricles* triquetrous, ovoid or ellipsoid, with flat faces, nerveless (except for two marginal nerves), glabrous, smooth, patulous, slightly recurved, finally dark brown, 2½–3½ by ¾–1 mm, subabruptly narrowed into a smooth or sparsely hispidulous-margined ¾–1 mm long beak; mouth subentire or bidenticulate. *Nut* ellipsoid or ovoid, triquetrous with flat faces, densely puncticulate, dilate-annulate at the apex, 1⅓–1½ by ¼–1 mm. *Style-base* thickened. Stigmas 3.

Distr. *Malesia*: Sumatra (G. Leuser), SW. Celebes (Mt Pokapindjang), New Guinea (W.: Carstensz Mts; NE.: Mt Hagen, Mt Michael, Mt Piora, Mt Wilhelm, Mt Sarawaket, Sattelberg; Papua: S. Highlands, Mt Ambua, Mt Giluwe, Mt Victoria, Owen Stanley Range).

Ecol. Open places, mountain heaths, alpine grasslands and swamps; 2400–4040 m.

Vern. New Guinea: *tudik*, Mendi language.

Note. The original descriptions of both *Carex celebica* and *C. constricta* were based on dwarf specimens a few cm tall. Collections recently made

in New Guinea have shown that the species can reach a height of 25 cm and the leaves a width of 5 mm. Stout specimens are very similar to 20. *C. verticillata*, a close ally of *C. celebica*, but easily distinguished by the long stipitate  $4\frac{1}{2}$ – $6\frac{1}{2}$  mm long utricles in the latter.

**18. *Carex perakensis*** C. B. CLARKE, Fl. Br. Ind. 6 (1894) 720; J. Linn. Soc. Bot. 37 (1904) 9; RIDL. Mat. Fl. Mal. Pen. (Monoc.) 3 (1907) 116; Fl. Mal. Pen. 5 (1925) 184; UITT. Rec. Trav. Bot. Néerl. 32 (1935) 201; NELMES, Kew Bull. (1950) 189; Reinwardtia 1 (1951) 253; Mém. Mus. Hist. Nat. Paris n.s. 4 (1955) 114; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 74, f. 18; Koyama, J. Fac. Sc. Un. Tokyo III, 8 (1962) 156; RAYM. Dansk Bot. Ark. 23 (1965) 259. — ? *C. arridens* CLARKE, Fl. Br. Ind. 6 (1894) 726; KÜK. Pfl. R. Heft 38 (1909) 548; RIDL. Mat. Fl. Mal. Pen. (Monoc.) 3 (1907) 117; Fl. Mal. Pen. 5 (1925) 184; NELMES, Reinwardtia 1 (1951) 333; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 139; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 74. — *C. tonkinensis* FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris III, 8 (1896) 251; KÜK. Pfl. R. Heft 38 (1909) 292; NELMES, Kew Bull. (1950) 190; Reinwardtia 1 (1951) 254; RAYM. Mat. Canad. 82 (1955) 165, f. 5. — *C. wightiana* NEES var. *perakensis* KÜK. Pfl. R. Heft 38 (1909) 288. — *C. leucostachys* RIDL. Kew Bull. (1928) 77; NELMES, Reinwardtia 1 (1951) 251; Mém. Mus. Hist. Nat. Paris n.s. 4 (1955) 113. — *C. nodiflora* (non BOECK.) KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 316. — *C. pseudorivulorum* KÜK. l.c. 319, *quoad specim. cit.*, non *C. rivulorum* RIDL. (basonym). — *C. setulifolia* NELMES, Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 116. — Fig. 119, 131b–d.

*Further synonyms under the varieties.*

Rhizome short or shortly creeping (thick) woody. Stems tufted, erect, trigonous or triquetrous, smooth or sparsely scabrid on the angles, especially above, 15–175 cm by  $\frac{1}{2}$ –4 mm below, surrounded below the leaves by brown to purplish brown bladeless sheaths or their fibrous remains. Leaves basal and subbasal, rarely spaced throughout the stem, shorter than to exceeding the stem, flattish, rather stiff, scabrid or smooth on the margins, asperous towards the long acuminate apex, (2–)3–16 mm wide; sheaths often dark nerved, hispidulous or puberulous at the mouth. Inflorescence usually consisting of 2–7 fascicles, or spikelets single, binate or ternate at each node; the fascicles formed by single spikelets (2–14 spikelets in the whole inflorescence), or by up to 20 panicles (in the whole inflorescence); the panicles consist of a very lax raceme of up to 10 secondary spikelets, each secondary spikelet subtended by a whether or not sheathing glumiform, often long awned bractlet, and surrounded at the base by an ocreiform cladophyll. The lower fascicles or spikelets distant, on long exserted smooth peduncles,

the higher approximate. Lower bracts foliaceous, long sheathing, the sheaths often ampliate; higher bracts much reduced, when glumiform the inflorescence is terminated by a seemingly more compound panicle. Spikelets androgynous, cylindric, but the ♂ part tapering, up to 10 in each panicle, the ♀ part mostly lax flowered, from much shorter to longer than the ♂ part, 3–8 mm thick. Glumes oblong to ovate or lanceolate acute to obtuse or acuminate, glabrous or hispidulous, nerved, light or red brown, or whitish to fulvous, usually with whitish hyaline margins,  $2\frac{1}{2}$ –7 mm long, the midrib just below the apex apiculate or excurrent into an up to 5 mm long awn. Utricles trigonous, oblong to narrowly ellipsoid, or obovoid,  $5$ – $9\frac{1}{2}$  by  $1$ – $2\frac{1}{3}$  mm, suberect to patulous, straight or obliquely bent at the apex, many-nerved, hispidulous, shortly stipitate or sessile, subabruptly beaked or gradually narrowed, beak bidentate, often with oblique mouth,  $1\frac{1}{2}$ –3 mm long. Nut trigonous with flat to slightly concave faces, ellipsoid to oblong ellipsoid or obovoid, shortly stipitate and beaked, 3–4 mm long. Style-base slightly thickened. Stigmas 3.

Distr. S. China (Yunnan and Kwangsi), Formosa, Tonkin, Annam, Laos, Lower Burma, Thailand; in *Malaysia*: Sumatra (Atjeh, East Coast, Palembang), Malay Peninsula (Perak, Larut, Pahang, Selangor), Borneo, SW. & SE. Celebes.

Ecol. See under the varieties.

Notes. The species is very variable, three varieties being distinguished. *Carex borneensis* seems at first sight to be a different species, although closely allied to *C. vansteenisii* s.s., because in most of the material of *C. borneensis* the spikelets are not compound. In the Malay Peninsula, however, this difference fades away, the spikelets of *C. borneensis* becoming also compound. *Carex vansteenisii*, a very rare plant, possesses exactly the same inflorescence as *C. perakensis*, the utricles are narrower, and their length overlaps with the range of those of *C. perakensis* (7–9 mm in *C. vansteenisii*, 5–6(–8) mm in *C. perakensis*).

NELMES distinguished also between *C. borneensis* and *C. kinabaluensis*, although there are no differences at all between the two. The Celebes collection (*C. eymae* NELMES) is young and differs hardly from the Bornean specimens of *C. borneensis*.

*Carex kinabaluensis* was considered an ally of 57. *C. brunnea*, as STAFF made a mistake in describing it as having 2 stigmas (in fact the number of stigmas is the only difference between the two sections!).

In the specimens of *C. borneensis* from the Malay Peninsula, as mentioned in the first note, some of the spikelets are branched (into 2–4 secondary spikelets). On account of this NELMES maintained *C. breviglumis* RIDL. as a species distinct from the Bornean plants of *C. borneensis*, in which the spikelets are usually unbranched. However, this difference does not always hold.

NELMES considered *C. tonkinensis* and *C. leuco-*



*stachys* specifically distinct from *C. perakensis* s.s., but I could not find differences, and his key characters are unfit for discrimination.

*Carex leucostachys* has been recorded from Pahang (P. Tioman), S. Sumatra (G. Pesagi), and Tonkin. In the type collection the inflorescence is a dense, head-like panicle, and the utricles are about 8 mm. The inflorescence is still too young for good description, but it shows resemblance with *C. vansteenisii* s.s. in the utricles, and several other collections show transitions to *C. perakensis* s.s.

CLARKE based *C. arridens* on two collections (Lower Burma, KURZ, n.v., and Perak, KING's coll. 2801). The Perak specimen, the only one ever collected in Malesia (in 1882) is very young with quite undeveloped flowers. It has the dark-nerved basal sheaths and the pale indumentum of the young utricles of *C. perakensis* s.s. The glumes are darker than is usual. In 1951 NELMES placed it in *subg. Carex*, but *C. perakensis*, *C. tonkinensis* and *C. leucostachys* in *subg. Indocarex*. The two subgenera he distinguished by their cladophylls (utriculiform in *subg. Indocarex*, ocreiform in *subg. Carex*). He described the cladophylls of *C. perakensis* as "utriculi-glumiform", those of *C. tonkinensis* as "more or less ocreiform" of *C. leucostachys* as "subocreiform below, glumiform above" and of *C. arridens* as "subutriculiform below, glumiform above". In 1955 he removed *C. tonkinensis* to *subg. Carex*, *C. leucostachys* and *C. perakensis* he left in *subg. Indocarex*.

#### KEY TO THE VARIETIES

1. Spikelets single or binate at the nodes, not compound. Utricles 5–9½ mm, gradually tapering into the 2–3 mm long beak. Leaves 2–8 mm wide  
b. var. *borneensis*
1. Spikelets compound, or when simple in fascicles at the nodes.
2. Utricles densely pale to golden hispidulous, subabruptly beaked, sessile, ellipsoid or ellipsoid-obovoid, 5–6(–8) mm long. Glumes translucent, whitish, or fulvous with broad whitish margins, 3½–5½ mm long. Inflorescence consisting of up to 20 panicles which are single, binate or ternate at the nodes. Each panicle consists of a raceme of up to 10 shortly peduncled 8–40 mm long secondary spikelets which is sometimes branched. The ♂ part of the spikelets from much shorter to longer than the ♀ part. Number of ♀ flowers usually less than 10 . . . . . a. var. *perakensis*
2. Utricles brown or olivaceous, gradually beaked, shortly stipitate, narrowly ellipsoid or fusiform, 5–9½ mm. Glumes light brown or reddish brown, the margin often whitish hyaline, 2½–7 mm long. Inflorescence consisting of 2–14 spikelets branched into 2–4 secondary spikelets, single or binate at the nodes, or 4–7 fascicles of spikelets or panicles.

3. Inflorescence consisting of 2–14 spikelets, which are often branched into 2–4 secondary spikelets, the ♂ part shorter to much longer than the ♀ part. Glumes 2½–4 mm long, light brown with whitish hyaline margins

b. var. *borneensis*

3. Inflorescence consisting of 4–7 fascicles of spikelets or panicles. The panicles consisting of a very lax raceme of up to 7 secondary spikelets. Spikelets (or secondary spikelets) up to 10 in each fascicle, lax flowered, the ♀ part much longer than the ♂ part. Glumes brown or reddish brown, 5–7 mm long

c. var. *vansteenisii*

a. var. *perakensis*. — All synonyms under the species. — Fig. 119, 131c–d.

Stems tufted, erect, trigonous or triquetrous, smooth or sparsely scabrid on the angles above, 60–175 cm by 2–4 mm. Leaves 4–12(–16) mm wide. Spikelets 1–2(–4) cm long, the ♂ part much shorter than the 5–7 mm thick ♀ part. Awn of glumes up to 1½ mm long. Beak of the 1½–2½ mm wide utricles 1½–2(–3) mm long, often obliquely bent.

Distr. China (Yunnan, Kwangsi), Formosa, Tonkin, Annam, Thailand, Lower Burma; in Malesia: Sumatra (Atjeh, E. Coast, Palembang), Malay Peninsula (Perak: Larut; Pahang, Selangor), Borneo (Sarawak: Mt Dulit; Sabah: Mt Kinabalu), SW. Celebes (Mt Poka Pindjang).

Ecol. In swampy localities and primary forest, 750–1700 m, on Mt Kinabalu up to 2700 m.

b. var. *borneensis* (CLARKE) NOOT., *comb. nov.* — *C. borneensis* CLARKE, J. Linn. Soc. Bot. 37 (1904) 14; Kew Bull. add. ser. 8 (1908) 76; KÜK. Bull. Jard. Bot. Btztg III, 16 (1940) 320, *incl. var. clemensis* (KÜK.) KÜK. *f. angustifrons* KÜK.; NELMES, Reinwardtia 1 (1951) 351. — *C. fusiformis* (non NEES) STAFF, Trans. Linn. Soc. II, 4 (1894) 246. — *C. fusiformis* NEES var. *borneensis* (CLARKE) KÜK. Pf. R. Heft. 38 (1909) 598. — *C. kinabaluensis* STAFF, J. Linn. Soc. Bot. 42 (1914) 183; NELMES, Kew Bull. (1950) 200; Reinwardtia 1 (1951) 349; *ibid.* 2 (1954) 377; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 82. — *C. rivulorum* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 195, *non* DUNN, 1908. — *C. breviglumis* RIDL. Fl. Mal. Pen. 5 (1925) 183; NELMES, Reinwardtia 1 (1951) 348. — *C. clemensis* KÜK. in Fedde, Rep. 29 (1931) 202. — *C. pseudorivulorum* KÜK. Bull. Jard. Bot. Btztg III, 16 (1940) 319, *quoad basionym.* — *C. eymae* NELMES, Kew Bull. (1950) 199; Reinwardtia 1 (1951) 352. — Fig. 119, 131b.

Stems erect, triquetrous, smooth or slightly scabrid, (15–)40–140 cm. Leaves shorter than to as long as the stem, (2–)3–5(–8) mm wide. Inflorescence narrow, up to 30 cm long, consisting of 2 to 14 spikelets. Spikelets up to 5 cm long, single or binate at the middle nodes, erect or suberect, simple or branched into 2–4 secondary spikelets, the ♂

part shorter to much longer than the lax-flowered 3–5 mm thick ♀ part. Glumes light brown with whitish hyaline margins, 2½–4 mm long, apiculate or midrib excurrent into an up to 5 mm long awn. Utricles olivaceous, 5–9½ by 1–2 mm, gradually tapering into a hispidulous margined, 2–3 mm long beak.

Distr. Annam (Prov. Kontum; Ngoe Pang); in *Malesia*: Malay Peninsula (Pahang: G. Tahan, G. Jasar, G. Berumban), Borneo (Sabah: Mt Kinabalu, Mt Tambuyokan, G. Alab; Sarawak: Mt Poë, Mt Dulit; SE. Borneo: W. Kutei), SE. Celebes (Enrekang). See the map by RAYMOND, *l.c.* p. 103.

Ecol. Wet places in forests and in shady places along streams; 800–3300 m.

Note. Specimens with very regularly puckered-bullate leaves were twice collected on Mt Kinabalu. The strange abnormality of the leaves may be due to some disturbance during the growth period. The same phenomenon has been observed in some *Aponogeton*, *Cryptocoryne*, and *Halophila* species.

*c. var. vansteenii* (KÜK.) NOOT., *comb. nov.* — *C. vansteenii* KÜK. Bull. Jard. Bot. Btzg III, 16 (1940) 320, *incl. var. brevispiculosa* KÜK. *l.c.* 321; NELMES, Reinwardtia 1 (1951) 444; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 141; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 73. — Fig. 119.

Stems rather stout, erect, triquetrous, smooth, *c.* 150 cm by 3–4 mm. Leaves shorter than the stem, stiff, 3–15 mm wide, sheaths shining membranous in front. Inflorescence consisting of 4–7 fascicles of panicles consisting of a very lax raceme of up to 7 secondary spikelets. Spikelets lax-flowered, 2–6 cm long, 4–8 mm thick, the ♀ part much longer than the ♂ part, from *c.* 4- to *c.* 10-flowered. Glumes (reddish) brown, 5–7 mm long, awn 0–1 mm long. Utricles exceeding the glumes, suberect to patulous, gradually narrowed into the 2–3 mm long beak, 7–9 by 1–1½ mm.

Distr. Tonkin, Laos; in *Malesia*: N. Sumatra (Atjeh: Losir massif).

Ecol. Mountain heaths, 2100–2500 m. In the Losir area this variety is found at higher altitude than *var. perakensis*.

19. *Carex turrita* C. B. CLARKE, J. Linn. Soc. Bot. 37 (1904) 13; Philip. J. Sc. 2 (1907) Bot. 108; Kew Bull. add. ser. 8 (1908) 74; KÜK. Philip. J. Sc. 5 (1911) Bot. 63; MERR. En. Philip. 1 (1923) 142; NELMES, Reinwardtia 1 (1951) 335. — Fig. 119, 131e–f.

See for synonyms under the varieties.

Rhizome short or shortly creeping, woody. Stems erect, trigonous, smooth, up to more than 1 m by ½–3 mm below. Leaves basal and up to 3 higher on the stem, shorter than the stem, stiff, flat or with slightly revolute margins, with scabrid margins and asperous upper surface towards the long attenuate apex, 2–7 mm wide; sheaths usually

reddish or purplish, glabrous, with concave to convex mouth, the basal ones fraying into fibres. Inflorescence an often interrupted slender panicle to 50 cm long, consisting of 3–8 fascicles, lower fascicles distant, upper approximate. Lower bracts foliaceous, shorter to longer than their fascicles but much exceeded by the stem, long sheathing, upper much reduced; sheaths similar to those of the stem. Lower spikelets often single or binate, upper 2–6 together, often branched into 2–6 secondary spikelets, all androgynous, the ♂ part from much shorter to longer than the ♀ part, 2–8 cm by 2–3½ mm, much exerted from their sheaths. Glumes oblong-ovate, obtuse to emarginate, glabrous or sparsely hispidulous towards the apex, dark red with wide white hyaline margins, nerved, 2–3½ mm long, the midrib excurrent into an up to 2 mm long hispidulous awn. Utricles trigonous, oblong to ellipsoid, slenderly nerved to nerveless except 2 submarginal nerves, dark red, reddish or brown, straight or slightly curved, glabrous or hispidulous, at least above, the margins sparsely hispidulous from the middle or above the middle upwards, 3–6 by ⅓–1 mm, gradually tapering into a hispidulous margined, 1–2 mm long bidentate beak. Nut triquetrous, ellipsoid, with flattish or concave faces, brown or fulvous, stipitate, 1½–3½ mm long. Style-base slightly thickened. Stigmas 3.

Distr. *Malesia*: Philippines and New Guinea.

*a. var. turrita*. — *C. turrita* C. B. CLARKE. — *C. walkeri* ARN. ex BOOTT *var. turrita* (CLARKE) KÜK. Pl. R. Heft 38 (1909) 546. — *C. atosanguinea* NELMES, Kew Bull. (1950) 197; Reinwardtia 1 (1951) 339. — Fig. 119, 131e–f.

Glumes 3–3½ mm long, with an awn of ½–2 mm. Utricles slenderly nerved, 5–6 mm long, with a beak of 2 mm. Nut 3–3½ mm long.

Distr. *Malesia*: Philippines (Luzon: Abra, Bontoc, Ifugao, Benguet), New Guinea (W. New Guinea: Mt Treub; NE. New Guinea: Morobe Distr.; Papua: W. Highlands, Kubor Range, E. Highlands, Central Div.).

Ecol. Open places in mossy forest, montane rain-forest, 1500–3040 m.

Vern. Philippines: *tangtaño*, Bon.

Notes. NELMES distinguished the New Guinean *C. atosanguinea* from the Philippine *C. turrita* by the simple spikelets of the former. Additional collections from New Guinea have shown that also here specimens with branched spikelets occur; it must, however, be admitted that in general the spikelets in the Philippines are more compound.

I have not seen *C. gibbsiae* RENDLE, J. Linn. Soc. Bot. 39 (1909) 180, from Fiji, which is, according to NELMES, closely related to his *C. atosanguinea*, but looking “very distinct because of its different colouring”. I suspect it to be also conspecific with *C. turrita*.



*b. var. merrillii* (KÜK.) NOOT., *comb. nov.* — *C. merrillii* KÜK. in Fedde, Rep. 8 (1910) 7; Philip. J. Sc. 6 (1911) Bot. 63; MERR. En. Philip. 1 (1923) 139; NELMES, Reinwardtia 1 (1951) 336; *ibid.* 2 (1954) 377. — *C. pullei* NELMES, Kew Bull. (1950) 198; Reinwardtia 1 (1951) 338. — Fig. 119.

Glumes 2–2½ mm long, awn up to ½ mm. Utricles nerveless to slenderly few-nerved, 3–3¾ mm long, with a beak of 1–1½ mm. Nut 1½–1¾ mm long.

Distr. *Malesia*: Philippines (Luzon, Ifugao, Benguet), New Guinea (W. New Guinea: Mt Treub; NE. New Guinea: Morobe Distr.).

Ecol. Mossy forest, open places along trails, also on steep slopes; 1800–2490 m.

Note. KERN (in manuscript) reduced *C. pullei* to *C. turrita* with a question-mark. He noted: "It seems to differ mainly by the smaller utricles only 3–4 mm long, and may represent a depauperated state". NELMES described the utricles as being "almost nerveless to rather slenderly 1–3-nerved". As these were the only differences between *C. turrita* and *C. merrillii*, I have reduced the latter to a variety of the former.

20. *Carex verticillata* ZOLL. & MOR. in Mor. Syst. Verz. (1846) 98; STEUD. Syn. 2 (1855) 222; MIQ. Fl. Ind. Bat. 3 (1857) 353; BOECK. Linnaea 41 (1877) 256; NELMES, Kew Bull. (1950) 195, *incl. var. havilandii* (CLARKE) NELMES *et var. lutescens* NELMES; Reinwardtia 1 (1951) 340; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 74; KERN in Bakh. & Bakh. f. Fl. Java 3 (1968) 488. — *C. hypsophila* MIQ. Fl. Ind. Bat. 3 (1857) 354; BOECK. Linnaea 41 (1877) 257; CLARKE, J. Linn. Soc. Bot. 37 (1904) 13; KÜK. Pfl. R. Heft 38 (1909) 546, f. 89, *incl. var. havilandii* (CLARKE) KÜK. *et var. verticillata* (ZOLL. & MOR.) KÜK.; in Hochr. Candollea 6 (1936) 432. — *C. walkeri* (non BOOTT) BOECK. Linnaea 40 (1876) 332, *p.p.*; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 65. — *C. tartarea* RIDL. J. Bot. 23 (1885) 35. — *C. havilandii* CLARKE, J. Linn. Soc. Bot. 37 (1904) 13; Kew Bull. add. ser. 8 (1908) 75. — *C. sumatrensis* CLARKE, J. Linn. Soc. Bot. 37 (1904) 13; Kew Bull. add. ser. 8 (1908) 75. — *C. turrita* (non CLARKE) KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 319. — *C. decora* BOOTT *var. losirensis* KÜK. *l.c.* — *C. phacelostachys* NELMES, Kew Bull. (1950) 195; Reinwardtia 1 (1951) 344, *incl. var. losirensis* (KÜK.) NELMES; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 72. — Fig. 119.

Rhizome creeping, woody. Stems solitary or somewhat tufted, erect, triquetrous, smooth, 25–100 cm by 1–2 mm, surrounded below the leaves by dark reddish, entire or fibrous remains of old leaf-sheaths. Leaves basal and 1–2 on the stem proper, shorter than to equalling the stem, flattish with often strongly revolute margins, stiff, coriaceous, with scabrid margins, asperous above especially towards the long-attenuated apex,

3–8 mm wide; sheaths of the lower leaves reddish to blackish red, upper ones pale. Inflorescence a lax to dense panicle, 15–50 cm long, consisting of 4–7 fascicles of up to 20 spikelets, lower fascicles rather distant, upper approximate. Bracts of the lower fascicles foliaceous, equalling or exceeding their fascicles but usually much exceeded by the whole inflorescence, long-sheathing, upper much reduced; sheaths ampliate, glabrous, the mouth often prolonged into a short tongue. Spikelets erect or somewhat nodding, slenderly cylindric, lax- to rather dense-flowered, up to 6 cm long, simple or longest ones sometimes branched into 1–3 short secondary spikelets, on slender, smooth peduncles more or less exserted from the sheaths; 1–2 spikelets of uppermost fascicle (sometimes of all the fascicles) ♂, remaining ones wholly ♀ or with a few ♂ flowers at the top; ♂ spikelets 1–2 mm thick, ♀ 3–5 mm. Glumes oblong-lanceolate, obtuse, glabrous, fulvous to dark reddish with wide whitish-hyaline margins, 3–4¾ mm long, the midrib often excurrent in a smooth or hispidulous awn up to 1 mm long. Utricles trigonous, narrowly ellipsoid, tapering at both ends, glabrous but the margins often hispidulous, nerveless or faintly nerved (except for the marginal or submarginal nerves), suberect to patulous, often somewhat recurved, long-stipitate, stipe (½–¾–1 mm, subabruptly beaked, blackish red to golden, 4–6½ by ¼–1 mm; beak almost linear, sparsely hispidulous-margined, bidenticulate, (1–)2–3 mm long. Nut triquetrous with flattish faces, ellipsoid, brown, 1¾–2 mm long. Style not or scarcely thickened at the base. Stigmas 3.

Distr. Laos, Tonkin; in *Malesia*: Sumatra, Malay Peninsula (Perak: G. Kerbau), Java, N. Borneo (Mt Kinabalu).

Ecol. Damp open places in forests, open places in the subalpine region, near craters; 2000–3750 m.

Notes. Variable as to the colour of glumes and utricles. In most of the Mt Kinabalu specimens the glumes and utricles are very dark; they were distinguished as *var. havilandii* (CLARKE) NELMES.

A collection from E. Java (G. Semeru), in which the glumes and utricles are pale golden to fulvous, was distinguished as *var. lutescens* NELMES.

*Carex phacelostachys* NELMES only could be distinguished by the utricles which are faintly nerved against nerveless in *C. verticillata*. The collection VAN STEENIS 9624 from Atjeh has been identified as *C. verticillata* by both NELMES and KERN; after careful examination of the utricles I could not find any difference with *C. phacelostachys*. I examined many utricles of *C. verticillata* with translucent light. Most of them are nerveless indeed, but others are faintly nerved, often only at the base, at least in plants from Sumatra and Borneo. — (Noot.)

The species might also be conspecific with *C. walkeri* ARNOTT *ex* BOOTT. — (Noot.)

## 7. Section Surculosae

RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 20, 21. — *Sect. Scabrellae* KÜK. Pfl. R. Heft 38 (1909) 286, *p.p.*; NERMES, Reinwardtia 1 (1951) 243.

Type species: *Carex oligostachya* NEES (lectotype).

21. *Carex oligostachya* NEES in Hook. J. Bot. Kew Misc. 6 (1854) 29; NERMES, Reinwardtia 1 (1951) 244; *ibid.* 2 (1954) 373; Kew Bull. (1955) 301; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 95; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 22. — *C. cumingiana* STEUD. Syn. 2 (1855) 206; MIQ. Fl. Ind. Bat. 3 (1856) 349; BOOTT, Ill. 3 (1862) 107, t. 324, 325; BOECK. Linnaea 40 (1876) 367; F.-VILL. Nov. App. (1882) 310. — *C. rhizomatosa* STEUD. [in Zoll. Syst. Verz. 1 (1854) 60, *nomen*] Syn. 2 (1855) 206; MIQ. Fl. Ind. Bat. 3 (1856) 348; CLARKE, Fl. Br. Ind. 6 (1894) 721; J. Linn. Soc. Bot. 37 (1904) 12; Philip. J. Sc. 2 (1907) Bot. 108; KÜK. Pfl. R. Heft 38 (1909) 289, f. 44, *excl. var. impunctata* (BOOTT) KÜK.; Philip. J. Sc. 6 (1911) Bot. 61; CAMUS, Fl. Gén. I.-C. 7 (1922) 193; MERR. En. Philip. 1 (1923) 141; KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 316, *incl. var. aristulata* KÜK.; S. T. BLAKE, J. Arn. Arb. 28 (1947) 107; NERMES, Kew Bull. (1949) 378, 387. — *C. bukaënsis* PALLA in Rechinger, Bot.-Zool. Ergebn. Samoa & Solomon Ins. (1913) 58. — *C. breviceps* KÜK. Bot. Jahrb. 69 (1938) 263. — Fig. 120.

Rhizome shortly creeping, woody, like the stem-base clothed with brown or blackish, fibrous remains of old leaf-sheaths. Flowering stems lateral, approximate, subscapiform (bearing a few short-bladed leaves), triquetrous, smooth, 20–90 cm by  $\frac{3}{4}$ –2 mm. Leaves of the sterile shoots shorter than the flowering stems, stiffish, flat, rather abruptly acuminate, scabrid in the upper part, glaucous, 2–5 mm wide. Inflorescence a narrow panicle consisting of 6–12 head-like or racemose partial inflorescences, 10–50 cm long; partial inflorescences erect, subglobose to oblong-ovoid, with 1–8 spikelets, the lower ones single at the nodes, distant, on long-exserted, setaceous peduncles, the upper ones more approximate, unequally binate

(rarely ternate); axis and top of peduncles scabrid. Bracts foliaceous with blades shorter than 8 cm, their sheaths amplate, membranous near the mouth, the upper ones much reduced, infundibuliform. Spikelets androgynous, ovoid to subcylindric, sessile, 4–10 mm long, the ♂ and ♀ parts usually about equal in length. Glumes ovate or lanceolate, acutish to slightly notched, usually sparsely hispidulous towards the apex, 5–10-nerved, brown, often with reddish spots, whitish hyaline-margined, 2–3 mm long, the midnerve usually excurrent in a short, scabrid awn up to 1 mm long. Utricles obtusely trigonous, ellipsoid, subinflated, patent, straight, glabrous or sparsely hispidulous in the upper  $\frac{1}{3}$ , strongly many-nerved, rather abruptly beaked, fuscous,  $2\frac{1}{4}$ –4 by 1–2 mm; beak  $\frac{3}{4}$ –1 mm long, bidenticulate. Nut trigonous, ellipsoid or obovoid, minutely stipitate,  $2$ – $2\frac{1}{4}$  by  $1$ – $1\frac{1}{4}$  mm. Style-base not thickened. Stigmas 3.

Distr. Assam, Upper Burma, S. China, Tonkin, through Malesia to the Solomon Is.; in Malesia: Sumatra (Atjeh, Tapanuli), Lesser Sunda Is. (Sumba, Sumbawa, Flores), Philippines (Luzon, Negros, Mindanao), SE. Celebes (Buton I.), New Guinea. According to MERRILL, *l.c.*, also in the Moluccas.

Ecol. In Imperata-fields, on open grassy slopes, often in places where the grass is burned annually; from low altitude up to 1400 m.

Vern. New Guinea: *simboro*, Orokaiva lang.

Notes. The utricles vary from wholly glabrous (*C. breviceps* KÜK.) to sparsely hispidulous above.

I have not seen *C. breviceps* var. *recurvirostris* KÜK. Bot. Jahrb. 70 (1940) 464, based on CLEMENS 8032 from NE. New Guinea, Morobe, Sattelberg. Stems 90 cm tall. Leaves 5–10 mm wide. Panicle 35 cm long. Spikelets longer, broadly oblong. Utricles green, subabruptly excurrent in a long, recurved beak.

## 8. Section Rhomboidales

KÜK. Pfl. R. Heft 38 (1909) 622; NERMES, Reinwardtia 1 (1951) 383; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 54, 66.

Type species: *Carex chinensis* RETZ. (lectotype).

22. *Carex anomocarya* NERMES, Kew Bull. (1950) 202; Reinwardtia 1 (1951) 383; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 163; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 66, f. 16, map p. 102, f. 32; Dansk Bot. Ark. 23 (1965) 259; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 489. — *C. harlandii* (non BOOTT) MERR. & CHUN, Sunyatsenia 2

(1935) 208. — *C. harlandii* BOOTT var. *angustior* KÜK. ex BACK.; GROSS, Notizbl. Berl.-Dahl. 14 (1938) 193; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 65. — *C. harlandii* BOOTT f. *longibracteata* GROSS, Notizbl. Berl.-Dahl. 14 (1938) 193. — *C. manca* BOOTT var. *contigua* GROSS, *l.c.* — Fig. 120, 128.





Fig. 128. *Carex anomocarya* NERMES. a. Habit,  $\times \frac{2}{3}$ , b. glume, c. fruit in utricule, d. fruit, all  $\times 6$  (RAHMAT SI BOEEA 10601).

Rhizome short, not creeping. *Stems* central, erect, triquetrous, smooth, 30–70 cm by  $1\frac{1}{2}$ –2 mm. *Leaves* basal (rarely one in the middle of the stem), flat, weak, scabrid on the margins, 6–15 (–20) mm wide. *Inflorescence* with 3–5 spikelets, erect; terminal spikelet ♂, cylindric,  $2\frac{1}{2}$ –5 cm by c. 2 mm, peduncled, lateral ones ♀, oblong-cylindric, approximate with one another and with the ♂ spikelet, but lowest often distant, subdense-flowered, on shortly exerted peduncles, 4–8 cm by 6–9 mm; peduncles stoutish, smooth. Bracts foliaceous, lower usually much exceeding the inflorescence, shortly sheathing; sheaths pale, membranous in front or only at the mouth, subampliate. *Glumes* of the ♀ spikelets oblong, subtruncate to slightly emarginate, dirty white with hyaline margins and 3-nerved centre, ciliolate at the apex, awned, 3– $4\frac{1}{2}$  mm long, those of the ♂ spikelets narrower, also long-awned; awns scabrid, up to 1 cm long. *Utricles* ellipsoid to rhomboid-lageniform, obtusely trigonous, surface uneven with concavities and convexities corresponding to the surface of the nut, densely many-nerved, coriaceous, glabrous, straight, suberect, shortly stipitate, stramineous, 7–8 (–10) by  $2\frac{2}{3}$ –4 mm, rather abruptly narrowed into a  $2\frac{1}{2}$ –4 mm long, conical, bidentate beak; teeth  $1\frac{1}{2}$  mm long, diverging, sparsely hispidulous at the mouth. *Nut* unevenly ellipsoid or ovoid, distorted-trigonous, excavate on the angles at the centre, with concave faces below, stipitate, abruptly beaked, 4– $5\frac{1}{2}$  mm long; beak cylindric,  $\frac{1}{2}$ – $1\frac{1}{4}$  mm long, expanding into the annulate apex. *Style-base* pyramidally thickened, persistent. Stigmas 3.

Distr. N. Burma, NE. Thailand, Tonkin, Annam, Hainan; in *Malesia*: N. Sumatra (E. Coast: Dolok Singgalang and G. Batu Lopang; Toba), W. Java (Priangan: Tjadas Malang S. of Tjiandjur; Mt Bèsér near Tjidadap).

Ecol. In damp shady forest, in W. Java 1000–1200 m, in N. Sumatra at 1400–1700 m.

Note. Very near to *C. harlandii* BOOTT, Ill. 2 (1860) 87, t. 255; KÜK. Pfl. R. Heft 38 (1909) 630, f. 107, and possibly better treated as a race of that species. In *C. harlandii* the leaves are broader (up to 3 cm wide), the bracts much shorter, often not or hardly overtopping spikelet, the glumes of the ♂ spikelet rounded at the apex and mucous, those of the ♀ spikelets but shortly awned, the teeth of the utricles shorter (c.  $\frac{1}{2}$  mm long), and the beak of the nut slender, c.  $1\frac{1}{2}$  mm long. It is known from South and Central China.

(em. ed.) 10 (1949) fam. 246, p. 66; NELMES, Reinwardtia 1 (1951) 384; Koyama, Bot. Mag. Tokyo 70 (1957) 352, f. 10 & 12 A-A'; *ibid.* 72 (1959) 303; J. Fac. Sc. Un. Tokyo III, 8 (1962) 230; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 490; STEEN. Mt. Fl. Java (1972) pl. 14–3.

*ssp. jackiana*. — Fig. 120.

Rhizome short. *Stems* central, tufted, erect, triquetrous (angles prominent to narrowly winged), smooth, 15–100 cm by 1–2 mm, surrounded at the base by a few brownish sheaths or their fibrous remains. *Leaves* subbasal, sometimes one higher on the stem, shorter than to as long as the stem, flat, rather weak, scabrid at the top, 3–10 mm wide; sheaths pale to whitish. *Inflorescence* with 3–7 spikelets, erect; terminal spikelet ♂ (sometimes gynaeandrous), slenderly cylindric (or clavate), 1–3 cm by 2–4 mm, lateral ones ♀ (rarely androgynous), oblong-cylindric, sublux-flowered, 1–3 cm by 5–8 mm, upper erect, crowded with the ♂ spikelet, sessile or very shortly peduncled, lower distant on included to long-exserted, slender, smooth peduncles, often with 1–3 shorter spikelets branching from their peduncles. Bracts foliaceous, exceeding the inflorescence, lower long-sheathing, upper much shorter, scarcely to shortly sheathing. *Glumes* oblong-ovate, acute, very thin, dirty white with 3-nerved, greenish, central stripe, mucous or mucronulate, rarely with a short awn, 3– $5\frac{1}{2}$  mm long. *Utricles* fusiform-ellipsoid, trigonous, subcoriaceous, densely and strongly many-nerved, glabrous, straight, suberect, shortly stipitate, olivaceous,  $5\frac{1}{2}$ – $7\frac{1}{2}$  by  $1\frac{1}{2}$ –2 mm, gradually narrowed into the conical, straight, bidentate beak; teeth  $\frac{1}{4}$ – $\frac{3}{4}$  mm long, hardly diverging, smooth. *Nut* oblong-obovoid to suborbicular, triquetrous with prominent angles, with faces shallowly concave below, very shortly stipitate, abruptly shortly beaked,  $2\frac{1}{4}$ –3 mm long. *Style-base* not thickened. Stigmas 3.

Distr. Ceylon, India (Assam, Khasia), Yunnan; according to NELMES (1951) 386 also in Australia; in *Malesia*: Sumatra (W. Coast: Mt Kerintji), West and Central Java. Distribution maps in Bot. Mag. Tokyo 72 (1959) 303; Phytologia 17 (1968) 408. *Ssp. parciflora* (BOOTT) KÜK., often considered specifically distinct, differs from *ssp. jackiana* by its smaller utricles and shorter glumes; in S. Sachalin, Japes, S. Kuriles, Kyushu, and S. Korea.

Ecol. In marshes, swamps, and grassy plains; 1350–2550 m.

23. *Carex jackiana* BOOTT, Proc. Linn. Soc. 1 (1845) 260; Trans. Linn. Soc. 20 (1846) 132; Ill. 1 (1858) 9, t. 25; STEUD. Syn. 2 (1855) 226; MIQ. Fl. Ind. Bat. 3 (1856) 353; BOECK. Linnaea 41 (1877) 277; CLARKE, Fl. Br. Ind. 6 (1894) 735, *excl. var. β*; J. Linn. Soc. 37 (1904) 15; KÜK. Pfl. R. Heft 38 (1909) 638; in Hochr. Candollea 6 (1936) 432, *excl. var. tumens* KÜK.; BACK. Bekn. Fl. Java

24. *Carex lateralis* KÜK. Pfl. R. Heft 38 (1909) 639; Bull. Jard. Bot. Btztg III, 16 (1940) 322; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 66; NELMES, Kew Bull. (1950) 204; Reinwardtia 1 (1951) 388; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 488. — *C. jackiana* BOOTT *var. minor* CLARKE, Fl. Br. Ind. 6 (1894) 735, *p.p. typ.* — *C. elmeri* KÜK. in Fedde, Rep. 8 (1910) 326;



ELMER, Leaf. Philip. Bot. 3 (1910) 853; KÜK. Philip. J. Sc. 6 (1911) Bot. 64; MERR. En. Philip. 1 (1923) 137; KÜK. Bull. Jard. Bot. Batz III, 16 (1940) 322. — Fig. 120.

Rhizome short, tufted. Flowering stems lateral, obliquely erect or somewhat cernuous, very slender to subfiliform, weak, triquetrous, smooth, (5–)20–50 cm by  $\frac{1}{4}$ –1 mm, surrounded at the base by a few brown sheaths or their fibrous remains, and bearing a few small, bract-like or subfoliaceous leaves. Leaves of the sterile shoots much overtopping the stems, flat, revolute on the margins, stiff, with very rough margins, asperous towards the apex, 3–7 mm wide. Spikelets 3–4, crowded at the apex of the stem, subsessile on shortly exserted or wholly included peduncles, sometimes one 1–3 cm lower down; terminal spikelet ♂, cylindric, 5–10 by  $\frac{1}{2}$ –1 mm, usually very inconspicuous when the lateral spikelets have developed utricles, few-flowered, lateral ones ♀, oblong, few- (up to 5-)flowered, erect, 7–12 by 5–7 mm. Bracts foliaceous, much exceeding the inflorescence, shortly sheathing. Glumes oblong or oblong-ovate, subacute to rounded, thin, whitish with 3-nerved greenish central stripe,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long, excurrent in a flat, scabrous awn  $1\frac{1}{2}$ –6 mm long. Utricles ovoid-ellipsoid, trigonous, membranous, suberect, many-nerved below but few nerves extending more than halfway towards the apex, sparsely pubescent to glabrous, stipitate, shiny, pale green, 5–7 by  $2\frac{1}{4}$  mm, subabruptly contracted into a long, conical, somewhat recurved, bidentate beak. Nut ovoid-ellipsoid, triquetrous, with faces concave in the lowest  $\frac{1}{3}$ , brown to fuscous, stoutly stipitate, scarcely or not beaked at the rounded apex, 3–4 mm long. Style thickened at the base. Stigmas 3.

Distr. Ceylon, India; in *Malesia*: S. Sumatra (Palembang: Air Njuruk), W. Java (Priangan: Mt Papandajan), Central Celebes, Philippines (Luzon, Mindoro, Negros), Lesser Sunda Is.: Flores (Mt Ranaká).

Ecol. In forests, on road-sides; 1400–2200 m.

Note. The type of this species is THWAITES CP 3198 *p.p.*, not CLARKE 11061 as cited by NERMES. CLARKE's description of *C. jackiana* var. *minor*, based on this THWAITES collection and on CLARKE 11061 (!) refers to the species described above. *Carex jackiana* var. *minor* is therefore synonymous with *C. lateralis* and cannot be maintained as a variety of *C. jackiana* alongside of *C. lateralis*, as was done by KÜKENTHAL. BOECKLER's description of *C. jackiana* (Linnaea 41, 1871, 277), cited by CLARKE in the synonymy of his var. *minor*, obviously refers to typical 23. *C. jackiana*.

VELDKAMP 7130 has the entirely hairy utricles of *C. lateralis*, but lacks the awn on the glume; in that respect it fits in 25. *C. loheri*. The leaves are also

intermediate between *C. loheri* and *C. lateralis*. When more material becomes available, it is not impossible that the two species will have to be united. — (Noot.)

See also note under 25. *C. loheri*.

25. *Carex loheri* CLARKE, J. Linn. Soc. Bot. 37 (1904) 14; Philip. J. Sc. 2 (1907) Bot. 108; KÜK. Pfl. R. Heft 38 (1909) 487; Philip. J. Sc. 6 (1911) Bot. 64, incl. f. *grandimacula* KÜK.; MERR. En. Philip. 1 (1923) 139; NERMES, Reinwardtia 1 (1951) 386. — Fig. 120.

Rhizome short, tufted. Flowering stems lateral, suberect or cernuous, filiform, weak, triquetrous, smooth, 10–40 cm by  $\frac{1}{4}$  mm, surrounded at the base by a few brown scales or their fibrous remains. Leaves crowded at the base, shorter than to exceeding the stems, flat with revolute margins, stiff, greyish or glaucous-green, with scabrid margins, asperous towards the apex,  $1\frac{1}{2}$ –3 mm wide. Spikelets 3–6, terminal ♂, cylindric, 7–15 by 1–2 mm, lateral androgynous, 6–10 by 4–6 mm, with ♂ and ♀ parts about equal in length and few-flowered, upper one often approximate with the ♂ spikelet, lower on long, subbasal ones pendulous on very long, setaceous, smooth peduncles. Bracts of the lower spikelets subbasal leaves, of the other lateral spikelets subfoliaceous, rather long-sheathing. Glumes oblong-ovate, acute, thin, many-nerved, muticous or mucronulate, whitish, c. 4 mm long. Utricles ovoid-ellipsoid, trigonous, membranous, suberect, many-nerved, shining, glabrous below, sparsely to densely pubescent above, shortly stipitate, shining, pale green, 6–7 by  $1\frac{1}{4}$ –2 mm, subabruptly contracted into a long, conical, somewhat recurved, bidentate beak. Nut ovoid or ellipsoid, triquetrous with concave faces, brown to fuscous, shortly stipitate, hardly beaked,  $3\frac{1}{4}$ –4 mm long. Style thickened at the base. Stigmas 3.

Distr. *Malesia*: Philippines (Luzon: Lepanto, Bontoc, Benguet, Rizal, Zambales, Laguna, Tayabas).

Ecol. Mossy forest, 1300–2400 m.

Vern. *Silak*, Ig.

Notes. Very similar to 24. *C. lateralis*, to which it is certainly closely related, though KÜKENTHAL placed it in a different section.

*Carex tatsutakensis* HAYATA, Ic. Pl. Form. 6 (1916) 133, f. 45; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 396; KOYAMA, Nat. Canad. 82 (1955) 204; Contr. Inst. Bot. Un. Montreal n. 70 (1957) 19, not rare in Formosa and, according to KOYAMA, also in Tonkin (not mentioned for this country by RAYMOND!) is very near to *C. loheri*.

Also *C. sublateralis* KOYAMA, Jap. J. Bot. 15 (1956) 180, f. 9, from E. China (Kiangsu) belongs to this group of very closely related species.

9. Section *Cryptostachyae*

(OHWI) NELMES, *Reinwardtia* 1 (1951) 363; RAYM. *Mém. Jard. Bot. Montréal* n. 53 (1959) 52, 61. — *Sect. Praecoces* CHRIST *subsect. Cryptostachydeae* FRANCH. ex OHWI, *Mem. Coll. Sc. Kyoto Imp. Un.* B11 (1936) 340.

Type species: *Carex cryptostachys* BRONGN.

26. *Carex cryptostachys* BRONGN. in Duperrey, *Voy. Coq. Bot.* (1828) 152, t. 25; MIQ. *Fl. Ind. Bat.* 3 (1856) 352; BOOTT, *Ill.* 3 (1860) 103, t. 310; BENTH. *Fl. Hongk.* (1861) 403; BOECK. *Linnaea* 40 (1876) 327; CLARKE, *Fl. Br. Ind.* 6 (1894) 714 ('*cyrtostachys*'); J. Linn. *Soc. Bot.* 36 (1903) 281; *ibid.* 37 (1904) 8; RIDL. *Mat. Fl. Mal. Pen.* (Monoc.) 3 (1907) 116; KÜK. *Pfl. R. Heft* 38 (1909) 471; CAMUS, *Fl. Gén. I.-C.* 7 (1922) 195, f. 27, 10-13; MERR. *En. Philip.* 1 (1923) 137; RIDL. *Fl. Mal. Pen.* 5 (1925) 181, f. 221; KÜK. in *Hoehr. Candollea* 6 (1936) 432; OHWI, *Mem. Coll. Sc. Kyoto Imp. Un.* B11 (1936) 342; ELMER, *Leaf. Philip. Bot.* 10 (1938) 3526; BACK. *Bekn. Fl. Java* (em. ed.) 10 (1925) fam. 246, p. 66; NELMES, *Reinwardtia* 1 (1951) 363; AKIYAMA, *Car. Far East. Reg. Asia* (1955) 176, t. 177; RAYM. *Nat. Canad.* 82 (1955) 151, f. 2; *Mém. Jard. Bot. Montréal* n. 53 (1959) 61, map p. 102, f. 34; *Dansk Bot. Ark.* 23 (1965) 258; KERN in BACK. & Bakh. *f. Fl. Java* 3 (1968) 491. — Fig. 120.

Rhizome elongate, horizontal or ascending, woody, clothed with fibrous remains of sheaths. Flowering stems arising from the axils of the leaves, and often almost hidden among them, single or binate, scapiform, suberect, flexuous, obtusely trigonous, smooth, 10-50 cm tall, with sheaths and peduncles almost from the base. Leaves crowded on a short stem, much longer than the flowering stems, firm, flat, long-acuminate, scabrid on the margins, grey- or glaucous-green, 3-18 mm wide, surrounded at the base with fibrous remains of older leaves. Inflorescence racemiform or paniculiform, with 6-30 spikelets; spikelets androgynous, oblong-lanceolate, lax-flowered, 8-30 by 3-5 mm; ♂ part

much shorter than the ♀ one. Bracts usually shorter than their spikelets, with funnel-shaped sheaths and short blades; peduncles sparsely scaberulous, lower exerted, upper included. Glumes ovate, amplexicaul, many-nerved, obtuse, ciliolate, often minutely appressed-hairy, whitish or stramineous, apiculate or mucronulate,  $2\frac{1}{4}$ - $2\frac{3}{4}$  mm long. Utricles oblong-rhomboid to obovoid-fusiform, obscurely trigonous, suberect, densely many-nerved, subcoriaceous, sparsely puberulous, ciliolate-scabrid on the margins, stramineous-green, stoutly stipitate, abruptly shortly beaked, with oblique, bidentate mouth,  $3\frac{1}{2}$ - $5\frac{1}{2}$  by  $1\frac{1}{2}$ -2 mm. Nut irregularly rhomboid-ellipsoid or oblong-obovoid, trigonous, with faces excavated at base and apex, broadly stipitate, seated on a spongy, disk-like body, c. 2 mm long; beak short, strongly deflexed; style bent upwards, thickened above, papillose. Stigmas 3. Vestigial rachilla sometimes present (according to KÜKENTHAL).

Distr. Formosa, Hainan, S. China (Kwangtung), Tonkin, Annam, Thailand, Queensland; in *Malesia*: Sumatra (also Banka), Malay Peninsula, W. Java, E. Borneo, Philippines (Luzon, Mindanao), Aru Is., New Guinea; the specimen in L from the Lesser Sunda Is. (leg. PLOEM) is probably mislabelled.

Ecol. In primary forests, on banks in woods, in open jungle, at low and medium altitude; in Malaya between 350 and 1200 m, in Banka at 40 m, in the Aru Is. at a few m above sea-level, in W. Java between 500 and 1250 m, in the Philippines ascending to 1000 m.

Vern. *Rumput ringgin*, Mal. Pen.; *ilat kampaän*, S.

10. Section *Lageniformes*

(OHWI) NELMES, *Reinwardtia* 1 (1951) 366; RAYM. *Mém. Jard. Bot. Montréal* n. 53 (1959) 54, 63. — *Sect. Praecoces* CHRIST *subsect. Lageniformes* OHWI, *Mem. Coll. Sc. Kyoto Imp. Un.* B11 (1936) 340.

Type species: *Carex formosensis* LÉV. & VAN. (lectotype).

27. *Carex breviscapa* C. B. CLARKE, *Fl. Br. Ind.* 6 (1894) 736; KÜK. *Pfl. R. Heft* 38 (1909) 474; ELMER, *Leaf. Philip. Bot.* 10 (1938) 3525; MERR. *En. Philip.* 1 (1923) 137; KÜK. *Bot. Jahrb.* 69 (1938) 265; BACK. *Bekn. Fl. Java* (em. ed.) 10 (1949) fam. 246, p. 64; NELMES, *Kew Bull.* (1949)

390; *Reinwardtia* 1 (1951) 369; *ibid.* 2 (1954) 380; RAYM. *Mém. Jard. Bot. Montréal* n. 53 (1959) 63, f. 14, map p. 102, f. 33; *Dansk Bot. Ark.* 23 (1965) 258; Koyama, *Phytologia* 17 (1968) 405, t. 14; KERN in BACK. & Bakh. *f. Fl. Java* 3 (1968) 489. — *C. jackiana* BOOTT *var. breviculmis* THW. *En. Pl.*



Zeyl. (1864) 356. — *C. curtisii* RIDL. Mat. Fl. Mal. Pen. (Monoc.) 3 (1907) 117; Fl. Mal. Pen. 5 (1925) 183. — *C. lutchuensis* OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B5 (1930) 270; *ibid.* B11 (1936) 343, f. 5, t. 9 f. 8; AKIYAMA, Car. Far East. Reg. Asia (1955) 177, t. 178. — Fig. 120.

Rhizome short, caespitose. *Stems* central, sometimes more stems together, more or less hidden amongst the leaves, suberect, triquetrous, smooth, 5–20(–30) cm by c. 1 mm. *Leaves* basal, very much longer than the stems, flat, long-acuminate, scabrid on the margins and upper surface, 3–6(–8) mm wide; lower leaves reduced to bladeless brown sheaths or their fibrous remains. *Spikelets* usually 5–7, single at the nodes, erect or suberect, cylindric, lax-flowered, lower ones somewhat distant; terminal spikelet ♂, 1–2 cm long, 1 mm thick, often overtopped by some of the ♀ spikelets; lateral spikelets ♀ or with some ♂ flowers at the top, 1–3 cm by 3–4 mm; peduncles scaberulous, lower ones exserted. Lower bracts foliaceous, much exceeding the inflorescence, shortly sheathing, upper much reduced. *Glumes* broadly ovate to oblong-ovate, usually rounded at the erose apex, much shorter than the utricles, slenderly nerved, with not or slightly (up to 1 mm) excurrent midnerve and hyaline margins, ciliolate, 2–3 mm long. *Utricles* rhomboid-lageniform, trigonous, broadest about the middle, subcoriaceous, straight, suberect, strongly multinerved, glabrous or sparsely puberulous above, stramineous or greenish, stipitate,  $3\frac{1}{2}$ –4 $\frac{1}{2}$  by  $1\frac{1}{4}$ –1 $\frac{1}{2}$  mm; beak hispid, bidenticulate,  $\frac{1}{2}$ –1 mm long. *Nut* narrowly rhomboid, triquetrous with concave faces, stipitate, truncate and hollowed out at the apex, dark brown with pale stipe, apex, and angles,  $2\frac{1}{4}$ –3 by  $1\frac{1}{4}$ –1 $\frac{1}{2}$  mm. *Style-base* slightly thickened. Stigmas 3.

Distr. Ceylon, NE. Thailand, Annam, Ryu Kyu Is., Formosa, N. Queensland; in *Malesia*: Sumatra (E. Coast Res., Lampongs), Malay Peninsula (Penang, Pahang, Negri Sembilan), W. Java, Borneo (Sarawak), Philippines (Luzon: Sorsogon; Palawan), W. & NE. New Guinea.

Ecol. In secondary forest, on forested ridges, from low altitude up to 1250 m.

Vern. *Ilat daun eurih*, S.

Note. In some of the ♂ flowers I observed stamens with connate filaments. — (NOOT.)

**28. *Carex gracilispica* HAYATA**, Ic. Pl. Form. 10 (1921) 62, f. 39; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 345; AKIYAMA, Car. Far East. Reg. Asia (1955) 178, t. 179; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 65. — *C. ligata* (non BOOTT) RIDL. Fl. Mal. Pen. 5 (1925) 181. — ? *C. tristachya* THUNB. var. *pseudopocilliformis* GROSS, Notizbl. Berl.-Dahl. 14 (1938) 191. — *C. malayana* NERMES, Kew Bull. (1950) 209; Reinwardtia 1 (1951) 366.

Rhizome short, caespitose. Flowering stems arising from basal leaf-axils, erect, compressed-

trigonus, smooth or scaberulous just below the inflorescence, 10–30 cm by  $\frac{3}{4}$ –1 mm. *Leaves* basal, much longer than the stems, plicate to flat, long-attenuated, with scabrid margins, 5–10 mm wide, surrounded at the base by brown, fibrous remains of old leaf-sheaths. *Spikelets* 4–6, approximate or lowest somewhat distinct, erect or suberect, cylindric, 1–3 $\frac{1}{2}$  cm long; terminal spikelet ♂, 1 mm thick, lateral ones single at the nodes, wholly ♀ or with some ♂ flowers at the top, lax-flowered, 2–3 mm thick, their peduncles shortly exserted, smooth or scaberulous. Bracts foliaceous, lower as long as or exceeding the inflorescence, shortly sheathing, upper much reduced. *Glumes* oblong-ovate, acute to obtuse, slenderly nerved, with not or slightly excurrent midnerve, whitish hyaline margins, and erose-ciliate apex, 3–4 mm long. *Utricles* lageniform, obscurely trigonous, subcoriaceous, broadest 2–2 $\frac{1}{2}$  mm from the base, straight, suberect, strongly multinerved, sparsely puberulous, stramineous or greenish, shortly stipitate, 5–7 by  $1\frac{1}{2}$ –1 $\frac{4}{5}$  mm; beak  $1\frac{1}{2}$ –2 mm long, bidenticulate. *Nut* oblong, triquetrous, with faces concave below, stoutly stipitate, slightly constricted at the apex and re-expanded into a cylindric, truncate neck  $\frac{2}{3}$ –1 mm long and wide, the whole nut 3–4 mm long. *Style-base* thickened, centred in the apical hollow of the nut. Stigmas 3.

Distr. Formosa, Indo-China (Annam, ?Tonkin); in *Malesia*: Malay Peninsula (Pahang: Mt Tahan).

Ecol. On Mt Tahan in damp woods by streams, at c. 1700 m.

**29. *Carex palawanensis* KÜK.** in Elmer, Leaflet. Philip. Bot. 4 (1911) 1169; MERR. En. Philip. 1 (1923) 140; NERMES, Reinwardtia 1 (1951) 263; *ibid.* 2 (1954) 374. — Fig. 120.

Rhizome probably shortly creeping. *Stems* triquetrous, sparsely scabrid just below the inflorescence, otherwise smooth, 25–50 cm by  $\frac{1}{2}$ –1 mm, surrounded below the leaves by the fibrous remains of old leaf-sheaths. *Leaves* basal and one half-way up the stem, exceeding the stem, long-attenuate, rigid, with revolute margins, scabrid in the upper part, grey-green with a metallic hue, 3–7 mm wide; cauline leaf long-sheathing. *Inflorescence* spiciform (or almost so when its lowest node bears 2 spikelets), 2–4 cm long. Lowest bract foliaceous, patent, much overtopping the inflorescence, shortly sheathing, upper one(s) much reduced. *Spikelets* 2–10, androgynous, subglobose, dense, sessile or on very short included peduncles, 5–8 mm long, the ♂ part about as long as the ♀, but inconspicuous when the utricles are fully developed. *Glumes* ovate or ovate-lanceolate, acutish or obtuse, nerved, minutely ciliolate, otherwise glabrous, brownish with whitish hyaline margins,  $1\frac{1}{2}$ –2 mm long, the midnerve excurrent in a hispidulous,  $\frac{3}{4}$ –1 mm long awn. *Utricles* much overtopping the glumes, trigonous, rhomboid-lageniform, with

prominent angles and somewhat concave faces, subcoriaceous, patulous, strongly many-nerved, straight, glabrous, smooth except for a few setae in the upper part, not stipitate, curved-tapering to the base, rather gradually narrowed into the beak, greenish brown,  $4\frac{1}{4}$ –5 by  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm; beak compressed, bidentate,  $1\frac{1}{2}$ –2 mm long, with slightly oblique mouth. *Nut* trigonous, broadly rhomboid, with thickened angles and concave faces, curved-tapering downwards to a short cylindric stipe and upwards to a stout, cylindric,  $\frac{1}{4}$ – $\frac{3}{4}$  mm long and  $\frac{1}{2}$ – $\frac{3}{4}$  mm wide neck, truncate at the apex, c.  $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm. *Style-base* slightly thickened, centred in the hollowed apex of the nut. Stigmas 3.

Distr. *Malesia*: N. Borneo (Sabah: Lahad Datu, Mt Silam; Sandakan) and SW. Philippines (Palawan: Mt Pulgar).

Ecol. Common in wet, sandy, gravelly soil among shrubs bordering streams in the hills at 150–600 m.

Note. Only known from the type collection, ELMER 13146 from Palawan and SAN 37905 and 43845 from Sabah.

**30. *Carex rhynchaenium*** CLARKE in Merr. Publ. Gov. Lab. Philip. n. 35 (1906) 5; Philip. J. Sc. 2 (1907) Bot. 108; Kew Bull. add. ser. 8 (1908) 79; KÜK. Pfl. R. Heft 38 (1909) 480; Philip. J. Sc. 6 (1911) Bot. 62; MERR. En. Philip. 1 (1923) 142; NELMES, Reinwardtia 1 (1951) 368; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 65. — *C. hatsuimana* OHWI, Jap. J. Bot. 7 (1934) 196; Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 344, f. 6, t. 9 f. 7; KOYAMA, Contr. Inst. Bot. Un. Montréal n. 70 (1957) 21, t. 3; AKIYAMA, Car. Far East. Reg. Asia (1955) 178; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 65, f. 15, map p. 102, f. 29. — Fig. 120.

Rhizome short, cespitose. *Stems* central, more or less hidden amongst the leaves, erect, triquetrous,

scaberulous above, 5–10(–30) cm by  $\frac{1}{4}$ – $\frac{1}{2}$  mm, surrounded below the leaves by brown, fibrous remains of old leaf-sheaths. *Leaves* basal, much longer than the stems, plicate to flat, long-attenuate, scabrid on the margins and upper surface, 1–3 mm wide; sheaths pubescent. *Spikelets* 3–6, upper approximate, lower distant, erect or suberect, cylindric, lax-flowered; terminal spikelet ♂, 1(–2) cm long, 1 mm thick, lateral ones ♀ or with some ♂ flowers at the top,  $\frac{1}{2}$ –2 cm long, 3–4 mm thick; peduncles smooth or scaberulous, lower exserted. Lower bracts foliaceous, much exceeding the inflorescence, upper much reduced. *Glumes* elliptic-ovate to oblong-lanceolate, acute or with rounded apex, slenderly nerved, with not or scarcely excurrent midnerve and hyaline margins, erose-ciliate towards the apex, 2–3 mm long. *Utricles* lageniform, trigonous, broadest c. 2 mm from the base, subcoriaceous, straight, suberect, strongly multinerved, more or less puberulous above, stramineous or greenish, shortly stipitate,  $5\frac{1}{2}$ – $6\frac{1}{2}$  by  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm; beak  $\frac{3}{4}$ –1 mm long, bidenticulate. *Nut* rhomboid, triquetrous, with faces concave below, stoutly stipitate, the apex subabruptly contracted into a cylindric, truncate neck c. 1 mm long and  $\frac{3}{4}$  mm broad, the whole nut c. 4 mm long. *Style-base* scarcely thickened, centred in the apical hollow of the nut. Stigmas 3.

Distr. Formosa, Tonkin, Annam; in *Malesia*: Philippines (Luzon: Kalinga, Pampanga, Bataan, Benguet, Laguna; Mindanao: Bukidnon, Zamboanga).

Ecol. On forested ridges in and near the mossy forest, 800–2100 m.

Note. I have not seen CLEMENS 34431 from Borneo (Mt Kinabalu?) which may belong here (cf. NELMES, l.c. 369).

## 11. Section *Mitratae*

KÜK. Pfl. R. Heft 38 (1909) 458; NELMES, Reinwardtia 1 (1951) 371; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 52, 60. — *Sect. Praecoces* CHRIST, Bull. Soc. Bot. Belg. 24 (1885) 14, *nomen*; MACKENZ. N. Am. Fl. 18 (1935) 183; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 339. — Type species: *Carex mitrata* FRANCH.

Note. In this section many species have been described which differ only in slight characters and in my opinion several must be combined or deserve at most varietal rank. With the existing keys of KÜKENTHAL, OHWI, and KOYAMA identification appears often impossible. — (Noot.).

**31. *Carex breviculmis*** R. BR. Prod. (1810) 242; BOOTT, Ill. 4 (1867) 181; BOECK. Linnaea 41 (1877) 209; BENTH. Fl. Austr. 7 (1878) 445; CLARKE, Fl. Br. Ind. 6 (1894) 746; KÜK. Pfl. R. Heft 38 (1909) 469; RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 247; S. T. BLAKE, J. Arn. Arb. 28 (1947) 112; NELMES, Kew Bull. (1949) 383; Reinwardtia 1 (1951) 373; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 489. — Fig. 121.

For synonyms see under the varieties.

Rhizome short (obliquely descending, woody). *Stems* tufted, slender, erect or oblique, (obtuse) trigonous, smooth, or scaberulous above, 1–40 cm by  $\frac{1}{2}$ –1 mm, clothed at the base by old leaf sheaths or their fibrous remains. *Leaves* basal and subbasal, from much shorter to much longer than the stems, often thickish, rigid, flat or with recurved or revolute margins, gradually attenuate to the triquetrous tip, smooth or mostly scabrid on margins and keel, 1–4(–6) mm wide. *Inflorescence*



simple, erect, with 3–7 approximate spikelets (sometimes lowest spikelet remote on a peduncle from the sheath of a basal leaf; in small plants sometimes only one ♂ and one ♀ spikelet, the other ♀ spikelets single on a long peduncle arising from the centre of the basal leaves together with the main inflorescence); terminal spikelet ♂, sometimes gynaeandrous (in *var. perciliata*), linear, 5–12(–20) by 1–2 mm, lateral ones ♀, sessile or (very) shortly peduncled, subglobose to shortly cylindrical, 5–15 (–30) by 3–4 mm, peduncles smooth or scabrous; lower bracts usually overtopping the inflorescence, foliaceous or setaceous, shortly sheathing, upper much reduced. *Glumes* ovate or oblong-ovate, acute to obtuse, whitish or brownish, excurrent into a scabrid awn in *var. breviculmis*, muticous or with a short mucro in the other varieties, whitish or brownish and then with white hyaline margins, 3-nerved in the centre, 2–3 $\frac{1}{4}$  mm long. *Utricles* obtusely or obsoletely trigonous, lanceolate to ellipsoid or obovoid, membranous, except the 2 marginal nerves nerveless or obscurely nerved to more distinctly nerved, subabruptly to gradually beaked, from densely hispidulous to only hispidulous on the margins or glabrous, not or scarcely stipitate, light brown to stramineous or fulvous, 2 $\frac{1}{2}$ –4 by c. 1 mm. *Nut* triquetrous, with faces concave below, ellipsoid or ovoid to obovoid, stramineous to fuscous, 1 $\frac{1}{2}$ –2 $\frac{1}{2}$  by c. 1 mm, suddenly contracted into a very short neck and then suddenly expanded into an annulate apex. *Style-base* thickened, persistent on the annulus (but when the nuts are falling the style-base probably has disappeared). Stigmas 3.

*Distr.* Widely distributed from the Himalayas to China, Japan and Formosa through *Malesia* to Australia and New Zealand.

*Note.* The length of the stem varies considerably, even on the same plant. The same holds for the nerves on the utricles and for their hairiness, but these characters are rather constant in a single specimen. For these reasons I consider *C. breviculmis* R. BR., *C. perciliata* NELMES, and *C. montivaga* S. T. BLAKE to be conspecific, although it is possible to discriminate between them on varietal rank.

#### KEY TO THE VARIETIES

1. *Glumes* whitish, 2–3 mm long, excurrent into a scabrid awn. *Utricles* greenish becoming light brown, subabruptly beaked, several-nerved, usually more or less pubescent or hispidulous, 2 $\frac{1}{2}$ –3 $\frac{1}{2}$  mm long . . . . . **a. var. breviculmis**
1. *Glumes* brownish with white hyaline margin, acute or obtuse, muticous or with a small mucro. *Utricles* stramineous to fulvous, gradually beaked, nerveless or faintly nerved, hispidulous to glabrous, 2 $\frac{1}{2}$ –4 mm.
2. *Utricles* usually hispidulous, at least above on the margins, 2 $\frac{1}{2}$ –3 mm . . . **b. var. perciliata**

2. *Utricles* glabrous, rarely obscurely hispidulous on the margins above, 3 $\frac{1}{2}$ –4 mm long

c. var. *montivaga*

**a. var. breviculmis.** — *C. leuchochlora* BUNGE, En. Pl. Chin. Bor. (1833) 68; KOYAMA, Act. Phytotax. Geobot. 16 (1955) 9; YOSHIKAWA, Ic. Jap. Car. 1 (1957) 104, t. 52; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 60. — *C. royleana* NEES in Wight, Contr. (1834) 127; BOOTT, Ill. 1 (1858) 6, t. 19; CAMUS, Fl. Gén. I.-C. 7 (1922) 195. — *C. eggitera* STEUD. Syn. 2 (1855) 220. — *C. breviculmis* ssp. *royleana* KÜK. Pfl. R. Heft 38 (1909) 469; Philip. J. Sc. 6 (1911) Bot. 62, incl. *var. kingiana* KÜK.; MERR. En. Philip. 1 (1923) 137. — *C. jackiana* BOOTT *var. tumens* KÜK. in Hochr. Candollea 6 (1936) 432. — *C. rugata* (non OHWI) NELMES, Reinwardtia 1 (1951) 378. — *C. conorrhyncha* NELMES, Kew Bull. (1956) 182. — **Fig. 121.**

*Distr.* As for the species; in *Malesia*: E. Java (Mt Tengger and Mt Jang), SW. Celebes (Mt Bonthain), N. Borneo (Mt Kinabalu), Philippines (Luzon), and New Guinea.

*Ecol.* Open grassy slopes, among shrubs, 1750–3900 m.

**b. var. perciliata** KÜK. Pfl. R. Heft 38 (1909) 469. — *C. breviculmis*: CLARKE, J. Linn. Soc. Bot. 37 (1904) 16. — *C. bulbostylis* *var. ciliato-marginata* KÜK. *et var. hispidula* KÜK. Bot. Jahrb. 70 (1940) 464; Bull. Jard. Bot. Btzg III, 16 (1940) 318. — *C. tricholoma* S. T. BLAKE, J. Arn. Arb. 28 (1947) 110, f. 3A. — *C. brevis* S. T. BLAKE, l.c. 111, f. 3B; NELMES, Kew Bull. (1950) 202; Reinwardtia 1 (1951) 375. — *C. perciliata* (KÜK.) NELMES, Kew Bull. (1946) 26; *ibid.* (1949) 383, 391; Reinwardtia 1 (1951) 374. — **Fig. 121.**

*Distr. Malesia*: N. Borneo (Kinabalu), SW. Celebes (Latimodjong Range: Mt Rante Mario), New Guinea (W. New Guinea: Star Mts; Papua and Territory of New Guinea).

*Ecol.* Rock crevices, open bare ground, wet grassland, forest glades, 2400–4200 m.

**c. var. montivaga** (S. T. BLAKE) NOOT., *comb. nov.* — *C. montivaga* S. T. BLAKE, J. Arn. Arb. 28 (1947) 109; NELMES, Kew Bull. (1949) 383; Reinwardtia 1 (1951) 377. — *C. bulbostylis* KÜK. Bot. Jahrb. 69 (1938) 264; Bull. Jard. Bot. Btzg III, 16 (1940) 317, *excl. var. et specim. Born., non* MACKENZ. 1915. — **Fig. 121.**

*Distr. Malesia*: New Guinea (Lake Habbema, Mt Wilhelmia, Star Mts, Mt Sarawaket).

*Ecol.* Bogs, alpine grassland, wet grassy slopes, along water, also in mossy forest, 3200–3450 m.

**32. Carex dolichostachya** HAYATA, Ic. Pl. Form. 10 (1921) 61, f. 38; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 375; KOYAMA, Bull. Arts & Sc. Div. Ryukyu Un. (Math. & Nat. Sc.) n. 3 (1959) 72; AKIYAMA, Car. Far East. Reg. Asia (1955) 204,

t. 208, f. 2. — *C. ligata* BOOTT var. *nexa* KÜK. Philip. J. Sc. 6 (1911) Bot. 63; MERR. En. Philip. 1 (1923) 39, *quoad specim. cit.*, non *C. nexa* BOOTT. — *C. multifolia* OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B5 (1930) 264; *ibid.* B11 (1936) 373; NELMES, Reinwardtia 1 (1951) 371; AKIYAMA, Car. Far East. Reg. Asia (1955) 202, t. 206; YOSHIKAWA, Ic. Jap. Carex 1 (1957) 122, t. 61. — *C. foliosissima* (non F. SCHMIDT) FRANCH. Carex As. Or. (1898) n. 232; KÜK. Pfl. R. Heft 38 (1909) 478. — Fig. 121.

Rhizome short, caespitose, or shortly stoloniferous. *Stems* arising from basal leaf-axils, trigonous, smooth or sparsely scaberulous above, (15–)30–60 cm by  $\frac{1}{2}$ –1 mm, bearing a few short-bladed, bract-like leaves. Basal leaves about as long as the stems, flat, with scabrid margins and under surface above, 3–10 mm wide; sheaths reddish brown to spadiceous, older fibrous. *Spikelets* 3–7, distant, erect or suberect; terminal spikelet ♂, linear, ( $1\frac{1}{2}$ –)3–6 cm by  $1\frac{1}{2}$ –2 mm, lateral ♀ or with a few ♂ flowers at the top, lax-flowered, ( $1\frac{1}{2}$ –)3–5 cm by  $2\frac{1}{2}$ –3 $\frac{1}{2}$  mm, on exserted, smooth or slightly scaberulous peduncles. Bracts vaginiform with a short blade or reduced to long, subampliate, bladeless sheaths. *Glumes* oblong or oblong-obovate, truncate or rounded at the crose-ciliate apex, translucent, whitish to brownish,  $2\frac{1}{2}$ –3 mm long, the 3-nerved centre excurrent in a short, hispidulous awn c.  $\frac{1}{2}$  mm long. *Utricles* fusiform, trigonous with flat faces, straight, membranous, suberect, strongly many-nerved, hispidulous especially above, greenish to light brown, 3–4 by c. 1 mm; beak conical, 1 mm long, bidenticulate. *Nut* ellipsoid to oblong-ellipsoid, triquetrous with shallowly concave faces, stoutly stipitate, contracted at the apex and re-expanded into a discoid,  $\frac{1}{3}$  mm broad annulus, c. 2 by 1 mm. *Style-base* pyramidally thickened. Stigmas 3.

Distr. Japan, Ryu Kyu Is., Formosa; in Malesia: Philippines (Luzon: Kalinga, Bontoc, Rizal).

Ecol. Clearings and along edges of primary forest, 1200–1600 m.

Notes. The distinction between *C. multifolia* OHWI, common in the montane regions of Japan, and *C. dolichostachya* HAYATA, occurring from the Ryu Kyu Is. and Formosa to Luzon, is mainly made on account of the different colour of the basal leaf-sheaths. I have followed KOYAMA, who united the two as neither this character nor the other slight differences are constant.

HATUSIMA, Mem. Fac. Agric. Kagoshima Un. 5, 3 (1966) 59, referred specimens from the Batan Is. (N. Luzon), mentioned above as *C. ligata* var. *nexa* KÜK. (non *C. nexa* BOOTT), to *C. sociata* BOOTT in A. Gray, Bot. Jap. (1859) 420; Ill. 4 (1867) 200; OHWI, Cyp. Japon. 2 (1943) 376. If this identity is true, *C. sociata* BOOTT would be the correct name for this species.

A specimen from Sarawak (Mt Murud, 2400 m,

NOOTEBOOM 2030) undoubtedly belongs to *sect. Mitratae*, possibly in the vicinity of *C. dolichostachya*. The utricles, however, are longer together with the nuts, and the leaves are smaller. — (NOOT.)

33. *Carex formosensis* LÉV. & VAN. Mém. Soc. Nat. Sc. Nat. Math. Cherb. 35 (1906) 216, *et in* Fedde, Rep. 5 (1908) 31; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 345; NELMES, Reinwardtia 2 (1954) 379; AKIYAMA, Car. Far East. Reg. Asia (1955) 178, t. 180. — *C. ligata* BOOTT var. *formosensis* (LÉV. & VAN.) KÜK. Pfl. R. Heft 38 (1909) 474; MERR. En. Philip. 1 (1923) 139. — Fig. 121.

Rhizome short, caespitose. *Stems* central, erect, trigonous, smooth, 10–25(–50) cm by  $\frac{1}{2}$ –1 mm. *Leaves* basal, shorter to longer than the stems, flat, long-attenuate, with scabrid margins, 2–4(–6) mm wide, surrounded at the base by brown, fibrous remains of old leaf-sheaths. *Spikelets* 3–7, subapproximate or lower more distant, erect or suberect, cylindric; terminal spikelet usually ♂, 1–2 cm long, 2–3 mm thick, lateral ones single at the nodes, usually gynaeceandrous, with very few ♂ flowers at the base, subdensely flowered,  $3\frac{1}{2}$ –5 mm thick, their peduncles smooth, upper shortly, lower rather long-exserted. Lower bracts foliaceous, shorter to longer than the inflorescence, lower long-sheathing, upper much reduced. *Glumes* oblong, truncate to bilobed-emarginate,  $1\frac{1}{2}$ –2 mm long, nerveless except for a greenish, strongly 3-nerved central stripe excurrent in a hispid, up to  $1\frac{1}{2}$  mm long awn. *Utricles* rhomboid, slightly lageniform or fusiform, trigonous, subcoriaceous, broadest below the middle, straight, suberect, multinerved, very sparsely puberulous, stramineous or greenish, shortly stipitate, c.  $3\frac{1}{2}$  mm by 1 mm; beak c. 1 mm long, bidentate. *Nut* rhomboid, trigonous, with deeply concave faces, shortly stipitate, slightly constricted at the apex and slightly re-expanding into a rather discoid-annulate  $\frac{1}{3}$ – $\frac{1}{2}$  mm wide apex, the whole nut c. 2(–2 $\frac{1}{2}$ ) mm long. *Style-base* slightly thickened. Stigmas 3.

Distr. Korea, Japan (Kyushu, Honshu), Formosa; in Malesia: Philippines (Luzon: Benguet Subprov., Ilocos Norte).

Ecol. Forested ridges, along streams and trails, on cliffs and steep banks in and near the mossy forest, 1000–2400 m.

Vern. *Egegedán*, Bon., *silak*, Ig.

34. *Carex tristachya* THUNB. Fl. Jap. (1784) 38; SCHKUHR, Riedgr. 2 (1806) 48, t. Ww f. 109; BOOTT, Ill. 4 (1867) 131, t. 424; KÜK. Pfl. R. Heft 38 (1909) 471; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 363; AKIYAMA, Car. Far East. Reg. Asia (1955) 195, t. 198; YOSHIKAWA, Ic. Jap. Carex 1 (1957) 118, t. 59.

The few Malesian collections belong to:



*var. pocilliformis* (BOOTT) KÜK. Pfl. R. Heft 38 (1909) 473, t. 75, f. A–F; Philip. J. Sc. 6 (1911) Bot. 62; MERR. En. Philip. 1 (1923) 142; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 364; YOSHIKAWA, Ic. Jap. *Carex* 1 (1957) 120, t. 60. — *C. pocilliformis* BOOTT, Ill. 4 (1867) 175, t. 593; NELMES, Kew Bull. (1949) 391; Reinwardtia 1 (1951) 381; AKIYAMA, Car. Far East. Reg. Asia (1955) 196, t. 199. — Fig. 121.

Rhizome short. *Stems* densely tufted, very slender, erect, trigonous, smooth, 10–40 cm by  $1/2$ –1 mm, clothed at the base with dark brown, more or less fibrous remains of old leaf-sheaths. *Leaves* basal and subbasal, as long as or shorter than the stems, rather rigid, flat, gradually attenuate,  $1\frac{1}{2}$ –4 mm wide. *Inflorescence* with 3–7 spikelets, erect, fastigate or lower spikelets more distant on exerted peduncles; terminal spikelet ♂ or gynaeandrous, cylindrical,  $1/2$ –3 cm by  $1/2$ –1 mm, lateral ones ♀, slenderly cylindrical, rather loosely flowered, 1–3 cm by  $2$ – $2\frac{1}{2}$  mm; peduncles smooth. Lower bracts foliaceous, shorter than to slightly exceeding the inflorescence, upper reduced. *Glumes* of the ♂ spikelet cup-shaped (the margins more than halfway connate in front) but not so in gynaeandrous spikelets, muticous, those of the ♀ spikelets ovate or oblong-ovate, rounded at the ciliolate apex, glabrous, muticous or mucronulate, light brown with whitish hyaline margins and 3-nerved central stripe, 2 mm long. *Stamens* monadelphous (filaments connate almost throughout their length), not always so in lower flowers. *Utricles* trigonous, ellipsoid, membranous, many-nerved, sparsely pubescent, suberect, recurved at the top, shortly stipitate, gradually tapering above, green to brownish,  $2\frac{1}{2}$ –3 by  $3/4$ –1 mm; beak subconical, glabrous or hispidulous-margined, bidenticulate,  $1/2$  mm long. *Nut* oblong-ovoid or oblong-ellipsoid, triquetrous with faces concave below, stipitate, c. 2 mm long, stramineous to dark brown, rounded above and abruptly contracted into a short neck which is suddenly expanded into the annulate apex. *Style-base* pyramidally thickened, persistent. Stigmas 3.

Distr. *Var. tristachya* occurs in Japan, Korea,

Central and Eastern China, *var. pocilliformis* is also in Japan and Korea, but extends more southwards, through the Ryu Kyu Is. and Formosa to *Malesia*: Philippines (Luzon: Benguet: Mt Pulog), Borneo (Mt Kinabalu), and New Guinea (NE.: Mt Sarawaket).

Ecol. Open meadows and grassy slopes, 2200–2700 m.

Notes. *Carex tristachya* is remarkable for its monadelphous anthers, a feature very rare in the genus (according to BARROS also found in *C. acaulis* D'URV. of the Falkland Is. [cf. BRONGN. in Duperrey, t. 28, f. A; ROEPER, Zur Flora Mecklenb. 2 (1844) 161]).

There is no agreement on the taxonomical status of *C. pocilliformis* BOOTT. Whereas CLARKE (J. Linn. Soc. Bot. 36, 1904, 315) did not distinguish it from *C. tristachya*, it was reduced to varietal rank by KÜKENTHAL, OHWI, and others, but maintained as a distinct species by NELMES and AKIYAMA. The main difference is to be found in the glumes of the ♂ flowers, which are said to have free margins in typical *C. tristachya*. I think the difference is only gradual, as in the latter the margins of the glumes are also connate, though at the very base only.

Glumes with united margins are very rare in the genus; they are also known in some North American species belonging to *sect. Phyllostachyae* TUCKERM. (see MACKENZ. N. Am. Fl. 18, 1935, 174).

*Carex tristachya* is very near to *C. mitrata* FRANCH. & SAV., the main difference being in the ♂ spikelets, of which the glumes are infundibuliform and the filaments connate in *C. tristachya*. But in *C. tristachya var. tristachya* the margins of the glumes are connate at the very base only, and sometimes they are free. Besides, even in *var. pocilliformis*, I found perfectly free filaments and anthers, especially in the lower flowers (e.g. MERRILL 6629). It is very well possible that the mentioned characters in the ♂ spikelets are not very important, and that *C. tristachya* and *C. mitrata* have to be considered as subspecies of a single species. — (NOOT.)

## 12. Section Radicales

(KÜK.) NELMES, Reinwardtia 1 (1951) 389; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 54, 75. — *Sect. Digitatae* FRIES *subsect. Radicales* KÜK. Pfl. R. Heft 38 (1909) 480.

Type species: *Carex radicalis* BOOTT.

35. *Carex malaccensis* C. B. CLARKE, Fl. Br. Ind. 6 (1894) 722; J. Linn. Soc. Bot. 37 (1904) 9; RIDL. Mat. Fl. Mal. Pen. (Monoc.) 3 (1907) 116; KÜK. Pfl. R. Heft 38 (1909) 289; RIDL. Fl. Mal. Pen. 5 (1925) 183; NELMES, Reinwardtia 1 (1951) 257. — Fig. 121.

Rhizome shortly creeping, woody, covered with brown, readily fraying scales. *Stems* tufted, slender, triquetrous, very narrowly winged above, smooth below, slightly scabrid on the angles above, up to 50 cm by  $1$ – $1\frac{1}{2}$  mm. *Leaves* basal and subbasal, shorter to longer than the stems, stiff, strongly



Fig. 129. *Carex speciosa* KUNTH. *a.* Habit,  $\times \frac{1}{2}$ , *b.* spikelet, lower part ♀, upper part ♂,  $\times 1\frac{1}{2}$ , *c.* glume, *d.* fruit in utricle, *e.* fruit, *f.* young stamens in glume, *g.* glume, *h.* seemingly connate filaments, *i.* filaments, all  $\times 13$  (WAITZ *s.n.*).



revolute when dry, long-attenuate, greyish green or glaucous, scabrous-asperous in the apical part, 2–6 mm wide; sheaths brown, membranous in front, outer ones bladeless. *Inflorescence* racemiform, consisting of 1–4 remote, subglobose or pyramidal heads on short (the lowest rather long), smooth or scabrid peduncles, each head composed of 1–4 crowded, sessile spikelets. Lower bracts foliaceous, much exceeding the inflorescence, not auricled, not or lowest very shortly sheathing, ultimately horizontally spreading, upper much reduced. *Spikelets* androgynous, the ♂ part about as long as or longer than the ♀, ovoid, patent, 5–10 mm long and wide. *Glumes* broadly ovate to oblong-ovate, obtuse, membranous, strongly nerved, ciliolate above, otherwise glabrous, white or light brown,  $2\frac{1}{4}$ –3 mm long, the midnerve excurrent in a stoutish, scabrid,  $\frac{1}{2}$ –1 mm long awn. *Utricles* trigonous, rhomboid or obovoid, membranous, suberect or patulous, strongly many-nerved, rather abruptly contracted into the beak, glabrous, narrowly marginate or winged, scabrid on the margins at the apex, stramineous,  $4\frac{1}{4}$ – $6\frac{3}{4}$  by  $1\frac{1}{2}$ – $2\frac{1}{4}$  mm; beak linear-conical, flattened, curved inwards, bidenticulate, with oblique mouth 1–2 mm long. *Nut* triquetrous, pyriform, scarcely stipitate, brown but densely overlain white-scurfy,  $2\frac{1}{4}$  by  $1\frac{3}{4}$  mm. *Style-base* pyramidally thickened, persistent on the nut. Stigmas 3.

Distr. *Malesia*: Malay Peninsula (Kedah, Langkawi Is.).

Ecol. On limestone along the sea-shore, on limestone rocks, at low altitude.

Notes. Like *Fimbristylis malayana* OHWI this interesting species is apparently endemic in the Langkawi Is., here exclusively growing on limestone. RIDLEY (*l.c.*) recorded it for Thailand, but it is not mentioned for that country either by NELMES or RAYMOND.

Its nearest ally is *C. leucantha* ARN. ex BOOTT, Proc. Linn. Soc. 1 (1845) 257; Trans. Linn. Soc. 20 (1846) 135; Ill. 1 (1858) 10, t. 28, from Ceylon and India, which differs by the long-sheathing lower bracts and the hairy utricles.

**36. *Carex ramosii* KÜK.** in Fedde, Rep. 8 (1910) 8; Philip. J. Sc. 6 (1911) Bot. 63; MERR. En. Philip. 1 (1923) 141; NELMES, Reinwardtia 1 (1951) 259; *ibid.* 2 (1954) 374. — Fig. 121.

Rhizome shortly creeping, woody, covered with brown, readily fraying scales. *Stems* very slender, erect but often curved, triquetrous, slightly incrassate just below the inflorescence, smooth, or slightly scabrid at the top, surrounded below the leaves by a few, bladeless, brown sheaths, 10–25 cm by  $\frac{1}{2}$ –1 mm. *Leaves* basal, up to twice as long as the stems, rigid, flat, with revolute margins when dry, long-attenuate, greyish green, scabrid in the apical part, 2–5 mm wide. *Inflorescence* either a single head of 1–3 sessile spikelets, ovoid or oblong-ovoid, 1–2 cm long, or spiciform with 1–2

additional subsessile heads near the base of the stem in the axil of a leafy bract very similar to and as long as the leaves. Bracts not sheathing, amplexicaul by ciliolate auricles, the lowest of the terminal head foliaceous, 5–10(–25) cm long. *Spikelets* androgynous, the ♂ part longer than the ♀ but finally hidden by the fully developed utricles, 6–10 by 5–7 mm. *Glumes* ovate-lanceolate, obtuse or acutish, membranous, strongly nerved, glabrous, stramineous with white margins,  $3\frac{1}{4}$ –4 mm long, the midnerve excurrent in a minutely scabrid,  $1\frac{1}{4}$ – $1\frac{3}{4}$  mm long awn. *Utricles* trigonous, ellipsoid-rhomboid, subcoriaceous, suberect, strongly many-nerved, distinctly winged almost all round, scabrid-margined, gradually narrowed into the beak, glabrous, stramineous or brownish, 6–8 by  $2\frac{2}{3}$  mm (wings included); beak compressed, subconical, bidenticulate, with oblique mouth, 3 mm long. *Nut* triquetrous, rhomboid-ellipsoid, sessile, livid, 3 by  $1\frac{1}{2}$ –2 mm. *Style-base* pyramidally thickened, persistent on the nut. Stigmas 3.

Distr. *Malesia*: Philippines (Luzon, Mindanao).

Ecol. In forest at medium altitude.

**37. *Carex speciosa* KUNTH**, En. 2 (1837) 504; MIQ. Fl. Ind. Bat. 3 (1856) 348; BOOTT, Ill. 1 (1858) 53; BOECK. Linnaea 40 (1876) 388, *incl. var. minor* BOECK.; CLARKE, Fl. Br. Ind. 6 (1894) 729; KÜK. Pfl. R. Heft 38 (1909) 481, *incl. var. courtallensis* KÜK. *et var. angustifolia* KÜK.; CAMUS, Fl. Gén. I.-C. 7 (1922) 197; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 63; NELMES, Reinwardtia 1 (1951) 390; *ibid.* 2 (1954) 381; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 160, *incl. var. angustifolia*; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 80; Dansk Bot. Ark. 23 (1965) 260; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 488, 492. — *C. concolor* NEES in Wight, Contr. (1834) 125, *non* R. Br. 1823. — *C. courtallensis* NEES ex BOOTT, Ill. 1 (1858) 52, t. 138, *incl. var. angustifolia* BOOTT; CAMUS, Fl. Gén. I.-C. 7 (1922) 197, f. 28, 1–8; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 78, f. 19. — *C. longispica* BOECK. Allg. Bot. Zeitschr. 2 (1896) 174. — *C. speciosa var. abscondita* KÜK. Bull. Jard. Bot. Btzg III, 16 (1940) 318. — *C. stenura* NELMES, Kew Bull. (1950) 202; Reinwardtia 1 (1951) 392. — Fig. 121, 129.

Rhizome short, descendent, woody. *Stems* tufted, erect or suberect, slender, triquetrous, often narrowly winged at the top, smooth or finely scaberulous, 5–50 cm by  $\frac{1}{2}$ – $1\frac{1}{2}$  mm, surrounded below the leaves by fuscous sheaths and fibres. *Leaves* subbasal, longer to much longer than the stems, stiff, flat (but margins revolute when dry), scabrous on the margins, asperous on the upper surface towards the long-attenuate apex, greyish or glaucous-green, 3–10 mm wide. *Spikelets* 1–3(–4), 5–20 cm distant from one another, lowest sometimes arising from a basal leaf-sheath, androgynous, cylindric, 2–8 cm long, rather laxly 6–18-flowered, on shortly exerted smooth peduncles,

the ♀ part 3–7 mm thick, half as long to about as long as the slender ♂ part. Bracts foliaceous, usually overtopping the inflorescence, sheathing. Glumes of the ♂ flowers with free margins or rarely the margins connate in front in the lower  $2\frac{1}{3}$ – $1\frac{1}{2}$ , those of the ♀ flowers triangular-broadly ovate, rounded to subacute, translucent, many-nerved, with prominent midrib, muticous, minutely ciliate above, long-persistent,  $2\frac{1}{2}$ –3 mm long. Utricles ovoid-ellipsoid or ovoid-pyramidal, triquetrous, coriaceous, suberect, strongly many-nerved, straight or slightly curved, with whitish-pubescent margins, greenish-stramineous, 4–7 by  $1$ – $2\frac{1}{2}$  mm, spongy at the base, gradually narrowed into the short, bidenticulate beak. Nut obovoid or ellipsoid, triquetrous, shortly stipitate, abruptly shortly beaked, pale to dark brown with prominent pale angles, 3–4 by  $1\frac{1}{2}$ –2 mm. Style-base pyramidally thickened, ciliate, persistent. Stigmas 3.

Distr. Widely distributed in India (from Nepal to Sikkim, also in S. India), S. China (Yunnan), Thailand, Indo-China; in *Malesia*: Sumatra (Atjeh, E. Coast Res.), Malay Peninsula (Ulu Kelantan: Bertam, Gua Musang), SE. Borneo (N. of Bandjermasin, once), and Java (rare in W. and E., more common in Central Java), also in Kangean I.

Ecol. Primary forest, often in teak-forest, distinctly preferring seasonal climatic conditions, in Borneo on dry serpentine rock (once), at low and medium altitude, from sea-level up to 1500 m.

Vern. Java: *ilat djepun*, S.

Notes. According to RAYMOND, *l.c.*, the leaves in *C. speciosa* are  $1\frac{1}{2}$ –2 mm wide, the number of spikelets 1–4, and the utricles 4–5 mm long. He kept *C. courtallensis* apart from *C. speciosa* on account of its broader leaves, the greater number of spikelets, and the larger utricles. The type-collection of *C. speciosa* (WALLICH 3391) does not answer RAYMOND's description of this species. I agree with NELMES that *C. courtallensis* is conspecific with *C. speciosa*; the specimens from Sumatra and Java agree very well with the type of *C. courtallensis* (WIGHT 991 in K).

The Bornean specimens are remarkable by the narrow leaves, the long, tail-like ♂ part of the spikelets, and especially by the infundibuliform glumes of the ♂ flowers (the last character not mentioned by NELMES). I have not seen the Tonkin specimens NELMES (1955) referred to *C. speciosa* var. *angustifolia* (BOOTT) KÜK. They have leaves only  $1\frac{1}{2}$ –2 mm wide, and utricles  $3\frac{1}{2}$ –4 mm long. It is not clear how NELMES distinguished between this variety and his *C. stenura*.

Another member of sect. *Radicales* from Lower Burma was described as *C. pterocaulos* NELMES in Hook. Ic. Pl. 35 (1947) t. 3467; Mém. Mus. Nat. Hist. Paris B4 (1955) 159, according to NELMES a very distinct species because of its widely winged stems, its sometimes empty bract, and the very

stout ♀ part of its spikelets. In some specimens collected in Thailand, Chiangmai, Doi Chiangdao, at 1200 m (SLEUMER & SMITINAND 1063, L), the stems are strikingly winged (4 mm broad) and the bracts very long and sometimes empty, but the glumes are only 3– $3\frac{1}{2}$  mm long, the (young) utricles 4 mm (not 4–5 mm and 6–7 mm respectively); the ♀ part of the spikelets is therefore not stouter than in *C. speciosa*. I doubt whether *C. pterocaulos* is specifically distinct from *C. speciosa*.

The polymorphism of the group is badly in need of special study.

The record of *C. speciosa* var. *angustifolia* for NE. New Guinea, based on CLEMENS 7909a (KÜK. Bot. Jahrb. 70, 1940, 465) is very doubtful for plant-geographical reasons.

The filaments are often coherent to such a degree as to give the impression of their being connate.

**38. *Carex tricephala* BOECK.** Flora 58 (1875) 263; KÜK. Pfl. R. Heft 38 (1909) 289; KOORD. Exk. Fl. Java 1 (1911) 205; KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 316; NELMES, Kew Bull. (1950) 190; Reinwardtia 1 (1951) 256; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 117; KOYAMA, Contr. Inst. Bot. Un. Montréal. 70 (1957) 15, t. 1; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 76; Dansk Bot. Ark. 23 (1965) 260; KERN in BACK. & BAKH. f. Fl. Java 3 (1968) 491. — *C. madoerensis* CLARKE, J. Linn. Soc. Bot. 37 (1904) 15; Kew Bull. add. ser. 8 (1908) 77. — *C. thorelii* CAMUS, Not. Syst. 1 (1910) 295; Fl. Gén. I.-C. 7 (1922) 196; NELMES, Kew Bull. (1946) 15, 23. — *C. plesiocephala* TURR. Kew Bull. (1910) 385; *ibid.* (1912) 427. — *C. hispidangula* KOYAMA, Nat. Canad. 82 (1955) 200, t. 1. — Fig. 121.

Rhizome shortly creeping, woody, covered with the fibrous, fuscous remains of old scales. Stems slender, triquetrous, narrowly winged just below the inflorescence, smooth below, antrorsely scabrous-setulose above, 10–50 cm by 1 mm (up to 2 mm in the winged part), the base clothed with the fibrous remains of old leaf-sheaths. Leaves basal and 1–2 cauline, shorter than to much exceeding the stems, rigid to rather weak, flat, with revolute margins when dry, long-attenuate, scabrid in the upper part, light green, 3–10 mm wide; cauline leaves long-sheathing; ligule short, triangular. Inflorescence spiciform, consisting of (1–)3–(4) dense, sessile, ovoid or subglobose spikelets 0–5 cm distant, and 6–10(–12) mm long and wide. Lower 1–2 bracts foliaceous, usually much exceeding the inflorescence, not sheathing, amplexicaul by ciliate auricles, upper much reduced. Spikelets androgynous, the ♂ part about as long as the ♀, but inconspicuous when the utricles are fully developed. Glumes oblong-ovate to ovate, membranous, nerved, densely setulose, white, or brownish with white margins,  $2\frac{1}{2}$ – $4\frac{1}{2}$  mm long; midnerve excurrent in a scabrid,  $\frac{1}{2}$ –1 mm long awn.



*Utricles* trigonous, ovoid or rhomboid-ovoid, membranous, patent, slenderly nerved, rather abruptly narrowed into the beak, densely hispidulous in the upper  $\frac{2}{3}$ , whitish or brownish, 4–6 by  $1\frac{1}{5}$ – $2\frac{1}{3}$  mm; beak conic-cylindric, bidentate, with slightly oblique mouth, 1– $2\frac{1}{2}$  mm long. *Nut* triquetrous, ellipsoid, rhomboid, or slightly obovoid, scarcely stipitate, cinereous, dark brown on the angles,  $2\frac{1}{2}$ –3 by  $1\frac{3}{4}$ –2 mm. *Style-base* pyramidally thickened, persistent on the nut. Stigmas 3.

Distr. Yunnan, Upper Burma, Thailand, Indo-

China; in *Malesia* only known from Madura I. off NE. Java (type locality!).

Ecol. In grassy fields on heavy calcareous marl, in muddy places in teak-forests, at low altitude (up to 200 m), obviously bound to a distinct seasonal climate and its range apparently coinciding with that of teak. See NELMES 1951, *l.c.*

Note. NELMES placed this species, together with *C. malaccensis* and *C. ramosii* in sect. *Stramentitiae*, but as RAYMOND 1959, *l.c.*, pointed out, it has very little in common with the other members of that section.

### 13. Section *Trachychlaenae*

DREJER, Symb. Caric. (1844) 9; KÜK. Pfl. R. Heft 38 (1909) 415. — *Sect. Anomalae* (*non* CAREY) NELMES, Reinwardtia 1 (1951) 413; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 54, 71.

Type species: *Carex hispida* WILLD. (lectotype).

39. *Carex maculata* BOOTT, Trans. Linn. Soc. 20 (1846) 128; Ill. 1 (1858) 9, t. 26; BOECK. Linnaea 41 (1877) 191; BENTH. Fl. Austr. 7 (1878) 447; CLARKE, Fl. Br. Ind. 6 (1894) 735; KÜK. Pfl. R. Heft 38 (1909) 427, *incl. var. neurochlamys* KÜK.; OHWI, Mém. Coll. Sc. Kyoto Imp. Un. B11 (1936) 434; KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 317, *incl. var. sanguineo-squamata* KÜK. et *f. humilior* KÜK.; OHWI & KOYAMA, Misc. Rep. Nat. Sc. Mus. Tokyo n. 5 (1952) 1, t. 1; AKIYAMA, Car. Far East. Reg. Asia (1955) 120, t. 105, f. 1; YOSHIKAWA, Ic. Jap. Carex 2 (1958) 206, t. 103; NELMES, Kew Bull. (1950) 205; Reinwardtia 1 (1951) 414; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 71; Dansk Bot. Ark. 23 (1965) 259; KERN in BACK. & BAKH. f. Fl. Java 3 (1968) 489; STEEN. Mt. Fl. Java (1972) pl. 14–5. — *C. neurochlamys* F.v.M. Fragm. 8 (1874) 258; NELMES, Kew Bull. (1949) 391; Reinwardtia 1 (1951) 413. — *C. samoensis* BOECK. Bot. Jahrb. 25 (1898) 588. — *C. elibates* NELMES, Kew Bull. (1937) 353; *ibid.* (1950) 205; Reinwardtia 1 (1951) 416. — *C. pruinosa* (*non* BOOTT) KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 317. — *C. pruinosa* BOOTT *f. tristigmatosa* BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 62. — **Fig. 121.**

Rhizome short, woody. *Stems* densely tufted, slender, erect, trigonous, smooth, (5–)15–60 cm by 1– $1\frac{1}{2}$  mm, surrounded below the leaves by a few ferrugineous or brownish, bladeless sheaths or their fibrous remains. *Leaves* subbasal, shorter to longer than the stems, flat with often revolute margins, greyish green, scabrous towards the long-attenuated apices, (1–)3–8 mm wide; sheaths pale to ferrugineous, membranous in front. Lower bracts sheathing, leaf-like, usually overtopping the inflorescence. *Spikelets* (2–)3–5(–6), upper approximate, lower distant, cylindric, densely flowered; terminal spikelet ♂, sessile, pale, 1–2 mm thick,

lateral ones ♀, suberect, dark, 1–4 cm by 3–5 mm, upper sessile or shortly peduncled, lower on short to long, firm, smooth peduncles. *Glumes* ovate or oblong-ovate, acute or subobtuse, thin, translucent, often minutely ciliolate, ferrugineous to castaneous with narrow whitish-hyaline margins and 3-nerved, pale green central stripe, mucous or scarcely mucronulate, 2–3 mm long. *Utricles* ellipsoid, compressed-trigonous, membranous, distinctly several-nerved, suberect to patulous, straight, glabrous but densely ferrugineous-papillose, scarcely stipitate, 2–3(–4) by 1– $1\frac{3}{4}$  mm, subabruptly contracted into a very short, up to  $\frac{1}{2}$  mm long, entire or slightly emarginate beak. *Nut* ellipsoid or obovoid, triquetrous, shortly stipitate and beaked,  $1\frac{1}{4}$ –2 by  $\frac{3}{4}$ – $1\frac{1}{4}$  mm, both stipe and beak usually bent. *Style-base* oblique, somewhat thickened. Stigmas 3 (rarely 2 in some fruits).

Distr. Widely distributed from Ceylon and India through Thailand, China, and Korea to Formosa, Japan and the Ryu Kyu Is., and through Malesia to Queensland, New South Wales, New Caledonia and Samoa; in *Malesia*: Malay Peninsula (Pahang), N. Sumatra (Atjeh), Java (West: Mt Papandajan; Central: Diëng Plateau; East: Jang plateau), Lesser Sunda Is. (Flores), Celebes (Minahassa, Poso), and New Guinea. Distr. map: MEUSEL, Vergl. Arealkunde 2 (1943) Karte 32c.

Ecol. In swamps, marshes, boggy meadows, wet mountain heaths, open places in mossy woods, 1600–3500 m.

Vern. New Guinea: *sisik*, Tomba, *toni*, *ititu*, Mendi, *era*, *teleleme*, Onim.

Notes. Very variable. I cannot follow NELMES in assigning specific rank to *C. neurochlamys* and *C. elibates*. His descriptions are fairly well covered by that of *C. maculata*. *C. elibates* has darker coloured glumes and often stiffer and narrower

leaves than typical *C. maculata*, and for this reason KÜENTHAL distinguished it as *var. sanguineosquamata*. The other characters given by NELMES are valueless: in all *Carices* with a ♂ terminal spikelet this spikelet may bear some ♀ flowers; the very short beak of the utricle in *C. maculata* is variable in length, and so it is in *C. elibates*. F.v.MUELLER distinguished *C. neurochlamys* from *C. maculata* mainly by the non-papillose, strongly nerved utricles, a mistake apparently due to inaccurate observation. According to NELMES the glumes in *C. neurochlamys* are usually mucronulate, not usually so in *C. maculata*; I fail to see any difference. KÜENTHAL reduced *C. neurochlamys* to varietal rank and distinguished it by the stouter

stems, the leaves much overtopping the inflorescence, and the many-nerved, less densely papillose utricles. These characters are not found in the New Guinea specimens referred to *C. neurochlamys* by NELMES.

*Carex maculata* is closely related to species of *sect. Praelongae* (*C. phacota* and *C. pruinosa*). One collection of N. Sumatra (DE WILDE c.s. 13251) has several fruits with only 2 styles, and becoming as long as 4 mm, thus exactly resembling the fruits of *C. pruinosa*. These fruits occur in the same spikelet as the 'normal' 3-styled fruits. Another deviating feature in this collection is that some of the utricles are not glabrous, but minutely scabrid on the margins. — (NOOT.)

#### 14. Section Capitellatae

MEINSH. Act. Hort. Petrop. 18 (1901) 280, 309; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 437; NELMES, Reinwardtia 1 (1951) 404; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 17, 18. — *Sect. Rarae* CLARKE, Kew Bull. add. ser. 8 (1908) 143. — *Sect. Unciniaeformes* KÜK. subsect. *Capitellatae* (MEINSH.) KÜK. Pfl. R. Heft 38 (1909) 100. — *Sect. Extensae* FRIES subsect. *Capitellatae* (MEINSH.) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 202.

Type species: *Carex capitellata* BOISS. & BAL.

40. *Carex capillacea* BOOTT, Ill. 1 (1858) 44, t. 110; BOECK, Linnaea 39 (1875) 37; BENTH. Fl. Austr. 7 (1878) 438; CLARKE, Fl. Br. Ind. 6 (1894) 713; J. Linn. Soc. Bot. 37 (1904) 7; Philip. J. Sc. 2 (1907) Bot. 107; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 441; S. T. BLAKE, J. Arn. Arb. 28 (1947) 101; NELMES, Kew Bull. (1949) 381; Reinwardtia 1 (1951) 405; *ibid.* 2 (1954) 381; AKIYAMA, Car. Far East. Reg. Asia (1955) 42, t. 6, f. 1 A-D; YOSHIKAWA, Ic. Jap. Carex 2 (1958) 218, t. 109; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 18; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 206; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 488; STEEN, Mt. Fl. Java (1972) pl. 14-8. — *C. simplicissima* F.v.M. Fragm. 9 (1875) 191. — *C. rara* (non BOOTT) STAFF, Trans. Linn. Soc. II, Bot. 4 (1894) 246; CLARKE, J. Linn. Soc. Bot. 37 (1904) 7; KÜK. Bull. Jard. Bot. Btzg III, 16 (1940) 313; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 64. — *C. rara* BOOTT ssp. *capillacea* KÜK. in Mats. Index Pl. Jap. 2 (1905) 130, *quoad* *synon.*; Pfl. R. Heft 38 (1909) 102; Philip. J. Sc. 6 (1911) Bot. 58; MERR. En. Philip. 1 (1923) 141; STEEN. Trop. Natuur 19 (1930) 87, 89 f. 14. — **Fig. 121, 130.**

Rhizome short, woody. Stems densely tufted, slender, erect, triquetrous, smooth or slightly scaberulous just below the inflorescence, 5-50 cm by  $1/2$ - $3/4$  mm, clothed below the leaves by brownish, bladeless sheaths and their fibrous remains. Leaves subbasal, much shorter than to slightly

exceeding the stems, flat or canaliculate, smooth or nearly so, erect,  $1/2$ -2 mm wide; sheaths pale, membranous in front. Spikelet solitary, terminal, androgynous, ovoid or shortly cylindric, densely but rather few-flowered, 5-15 mm long, the ♂ part c. 1 mm thick, shorter than to about as long as the ♀ part, the latter becoming 4-6 mm thick. Glumes ovate or oblong-ovate, obtuse to acutish, mucous, translucent, ferruginous to brown with narrow paler margins and 3-nerved, pale central stripe, caducous,  $1\frac{1}{2}$ -3 mm long. Utricles oblong-ovoid or oblong-ellipsoid, rounded at the base, obscurely trigonous, subinflated, membranous, finally widely patent to somewhat reflexed, glabrous, several-nerved, scarcely stipitate, often minutely reddish resinous-dotted,  $(1\frac{1}{2})$ - $2\frac{1}{2}$ - $3\frac{1}{2}$  (-4) by c. 1 mm, rather gradually tapering to a very short, subentire or slightly emarginate beak. Nut ellipsoid or oblong-ellipsoid, triquetrous, shortly stipitate, abruptly short-beaked, stramineous to brownish,  $1\frac{1}{2}$ - $2\frac{1}{2}$  by c. 1 mm. Style-base slightly thickened. Stigmas 3.

Distr. From the Himalayan region to Annam, Manchuria, Korea, Japan, and extending as far north as Sachalin (*var. sachalinensis* OHWI); through Malesia to Australia (New South Wales) and New Zealand; in Malesia: Sumatra (North: Atjeh; Central West: G. Singalang), W. Java (Mt Papandajan), N. Borneo (Mt Kinabalu), SW. Celebes (Mt Rante Mario), Philippines (Luzon), and New Guinea.



Ecol. Swamps, wet alpine grasslands, open seepages, wet borders of small streams, marshy places in forests, 2000–4000 m.

Vern. New Guinea: *ere, tep*, Mendi lang.

Notes. Closely related to the Indian *C. rara* BOOTT, Proc. Linn. Soc. 1 (1845) 284; Ill. 1 (1858) 44, t. 109. BOOTT distinguished *C. capillacea* from *C. rara* by the capillary stems and leaves, the shorter, ovoid spikelet, the smaller, reflexed, punctulate utricles, and the caducous glumes. Except for the much longer, linear spikelets ( $\sigma$  part much longer than the  $\varphi$  one), and the suberect utricles of *C. rara*, these characters are unreliable. The two might possibly better be regarded as subspecies of a single species.

In typical *C. capillacea* (var. *capillacea*) the stems and leaves are filiform and the utricles 2–2½ mm long. The above description comprises also stouter plants with leaves up to 2 mm wide and

utricles 3–4 mm long, which have been distinguished as:

var. *sachalinensis* (F. SCHMIDT) OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 442; AKIYAMA, Car. Far East. Reg. Asia (1955) 42, t. 6, f. 1 E–H; YOSHIKAWA, Ic. Jap. Carex 3 (1960) 386, t. 193. — *C. nana* BOOTT in A. Gray, Mem. Am. Ac. n.s. 6 (1859) 418; Ill. 4 (1867) 139, t. 44, f. 2, non CHAM. ex STEUD. 1855. — *C. uda* MAXIM. var. *sachalinensis* F. SCHMIDT, Reisen Amurl. (1868) 191. — *C. capillacea* var. *nana* FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris III, 8 (1896) 198. — *C. rara* ssp. *capillacea* var. *nana* KÜK. Pfl. R. Heft 38 (1909) 103. — *C. capillacea* var. *major* NELMES, Kew Bull. (1949) 381; Reinwardtia 1 (1951) 406.

Known from Sachalin, Japan, Korea, and Malesia. The Malesian specimens are often difficult to refer to one of the varieties.

### 15. Section Rhizopodae

OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 443; NELMES, Reinwardtia 1 (1951) 411; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 17. — Sect. *Extensae* FRIES subsect. *Rhizopodae* (OHWI) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 202.

Type species: *Carex rhizopoda* MAXIM.

41. *Carex eremostachya* S. T. BLAKE, J. Arn. Arb. 28 (1947) 99, f. 1A; NELMES, Kew Bull. (1949) 381; Reinwardtia 1 (1951) 412. — Fig. 121.

Rhizome creeping, slender, 1–2 mm thick, covered with brown, striate scales. Stems approximate or loosely tufted, erect or suberect, slender and rather flaccid, triquetrous, scabrid at the top, 20–45 cm by ½–1 mm. Leaves subbasal, as long as to longer than the stems, flat, shortly attenuate, glabrous, scabrid on margins and nerves towards the apex, 2–3 mm wide, the lower ones reduced to brown, entire, bladeless or short-bladed sheaths. Spikelet 1, terminal, erect, androgynous, oblong-ellipsoid to shortly cylindric, densely many-flowered, 10–15 by 5–6 mm, the  $\sigma$  part shorter than the  $\varphi$  one. Glumes ovate or ovate-lanceolate, acute or the upper obtusish, thin, glabrous, reddish brown with 3-nerved, pale, central stripe, 3–4 mm

long, lower mucronate (mucro up to 1 mm), upper muticous. Utricles ellipsoid, triquetrous, angled dorsally, obliquely erect, membranous, glabrous and smooth, distinctly 4–5-nerved on each face, pale green, 4½–5 by 1¼–1½ mm, shortly stipitate, rather abruptly narrowed into a slender, linear, bidentate, c. 1½ mm long beak. Nut obovoid, triquetrous, apiculate, c. 2 by 1⅓ mm. Style-base scarcely thickened. Stigmas 3.

Distr. Malesia: W. New Guinea, 9 km NE of Lake Habbema; only known from the type collection.

Ecol. Massed on open beaches of small stream in forest, 2800 m.

Note. Closely allied to *C. rhizopoda* MAXIM. from Japan, which is however clearly distinct by its more flaccid, usually broader leaves, and its longer, oblong-cylindric spikelet with pale green glumes much shorter than the utricles.

### 16. Section Anomalae

[CAREY in Gray, Man. Bot. N. Un. St. (1848) 557, *pro subsect.*]; MACKENZ. N. Am. Fl. 18 (1935) 339. — Japonicae FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris III, 10 (1898) 107, *nomen.* — Sect. *Tumidae* KÜK. Pfl. R. Heft 38 (1909) 611; AKIYAMA, J. Fac. Sc. Hokkaido Imp. Un. V, 2 (1932) 188; NELMES, Reinwardtia 1 (1951) 394; non MEINSH. 1901. — Sect. *Dispalatae* OHWI, Mem. Coll. Sc. Kyoto

Imp. Un. B11 (1936) 480; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 54, 82. — *Sect. Confertiflorae* FRANCH. ex OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 474; AKIYAMA, Car. Far East. Reg. Asia (1955) 144. — *Sect. Molliculae* OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 450; KOYAMA, Bot. Mag. Tokyo 72 (1959) 307; Quart. J. Taiwan Mus. 13 (1960) 226. — *Sect. Extensae* FRIES ser. *Tumidae* (KÜK.) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 202.

Type species: *Carex scabrata* SCHWEIN. (lectotype).

42. *Carex alopecuroides* D. DON, Trans. Linn. Soc. 14 (1825) 332; Prod. Fl. Nepal. (1825) 43; BOOTT, Ill. 2 (1860) 88, t. 258; BOECK. Linnaea 41 (1877) 172.

In *Malesia* only:

*var. chlorostachys* (D. DON) CLARKE, J. Linn. Soc. 36 (1903) 271 ('*chlorostachya*'); KOYAMA, Nat. Canad. 82 (1955) 199; Contr. Inst. Bot. Un. Montréal n. 57 (1957) 14; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 85; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 490. — *C. chlorostachys* D. DON, Trans. Linn. Soc. 14 (1825) 330; Prod. Fl. Nepal. (1825) 43; non STEVEN, 1813. — *C. doniana* SPRENG. Syst. 3 (1826) 825; NEES in Wight, Contr. (1834) 128; DREJER, Symb. Caric. (1844) 26, t. 13; S. T. BLAKE, J. Arn. Arb. 28 (1947) 115; Kew Bull. (1950) 204, incl. *var. cacuminis* NELMES; NELMES, Reinwardtia 1 (1951) 399; *ibid.* 2 (1954) 381; AKIYAMA, Car. Far East. Reg. Asia (1955) t. 161. — *C. japonica* (non THUNB.) BOOTT, Ill. 2 (1860) 88, t. 257, excl. *var. minor* BOOTT; BOECK. Linnaea 41 (1877) 283, excl. *syn. SCHKUHR* t. Ww f. 110; CLARKE, Fl. Br. Ind. 6 (1894) 736; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 70. — *C. japonica var. chlorostachys* KÜK. ex MATSUM. Ind. Pl. Jap. 2 (1905) 116; Pfl. R. Heft 38 (1909) 620; MERR. En. Philip. 1 (1923) 139; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 212. — *C. subtransversa* CLARKE, Philip. J. Sc. 2 (1907) Bot. 108; Kew Bull. add. ser. 8 (1908) 92; KÜK. Pfl. R. Heft 38 (1909) 614, *in nota*; Philip. J. Sc. 6 (1911) Bot. 63; MERR. En. Philip. 1 (1923) 142; S. T. BLAKE, J. Arn. Arb. 28 (1947) 115; NELMES, Reinwardtia 1 (1951) 401. — *C. japonica var. mesogyna* KÜK. Bot. Jahrb. 69 (1938) 265. — *C. japonica ssp. subtransversa* (CLARKE) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 213. — **Fig. 121.**

Rhizome emitting long, slender stolons covered with pale brown sheaths. *Stems* tufted, slender, erect, very acutely triquetrous to narrowly winged, smooth or scabrid on the angles above, (2–)30–90 cm by 1–2 mm, surrounded below the leaves by a few pale, bladeless sheaths. *Leaves* subbasal and 1 higher on the stem, shorter to much longer than the stem, flat, stiffish, long-acuminate, scabrid on the margins and often asperous on the upper surface, 2–10 mm wide. *Spikelets* (2–)3–6, erect, cylindric, (1½–)2–5 cm long, approximate and fastigiate, or lower 1–2 somewhat distant, sessile,

or lower shortly peduncled; terminal spikelet ♂ (not rarely gynaeandrous), pale, 1–3 mm thick, lateral ones ♀, greenish or stramineous, 4–6 mm thick. Lower bracts foliaceous, overtopping the inflorescence, not sheathing, upper much reduced. *Glumes* oblong-ovate, acute to obtuse, 2–2½ mm long, whitish with 3-nerved, green, central stripe excurrent in a scabrid, (¼–)1–1¾ mm long awn. *Utricles* ellipsoid, obscurely trigonous, subinflated, membranous, plurinerved, glabrous, ultimately patent, straight, greenish to stramineous, 3–4 by 1–1¼ mm, rather gradually narrowed into a 1–1¼ mm long, linear-conic, bidenticulate, smooth or almost smooth beak. *Nut* ellipsoid, obovoid, or oblong-obovoid, triquetrous, 1½–2 by ¾–1 mm. *Style* straight or slightly bent at the scarcely thickened base. *Stigmas* 3, about half as long as the utricle.

Distr. Nepal, Sikkim, and Khasia to Central and S. China, Korea, Japan, Ryu Kyu Is., Formosa, Tonkin, and Annam, and *Malesia*: Sumatra (Atjeh; W. Coast: Mt Kerintji), Java (Mt Wajang in W., Mt Tengger: Ranu Regulo in E.), Central Celebes (Mt Kambuno), Philippines (Luzon), and New Guinea.

Ecol. Margins of lakes, riversides, openings in the mossy forest, also on dry, open slopes, stated to be a common trackside sedge in New Guinea; 1500–2900 m.

Vern. New Guinea: *akele*, Lalibu.

Notes. The only collection known from Celebes (EYMA 1395) was distinguished as *C. doniana var. cacuminis* NELMES, which has no taxonomic value; the dwarfish habit has apparently been caused by continuous grazing of anoa, the small wild buffalo of Celebes, *Bos (Bubalus) depressicornis*.

Both *C. alopecuroides* and its *var. chlorostachys* are treated as varieties of *C. japonica* THUNB. by KÜKENTHAL, and also recently by KOYAMA, but *C. japonica* seems to be distinct by its short-cylindric, not crowded, peduncled, usually pendulous spikelets, not distinctly awned glumes, and its very long stigmas. In typical *C. alopecuroides* the leaves are usually narrower than in *var. chlorostachys*, the spikelets very slender, and the utricles somewhat narrower, less inflated, but the two are very near to each other and connected by intermediates. *C. subtransversa* CLARKE was described from N. Luzon, where also *C. alopecuroides var. chlorostachys* occurs. I fail to see differences





Fig. 130. *Carex capillacea* BOOTT. Habit,  $\times \frac{1}{3}$   
(from Mt Papandajan, VAN STEENIS).

between the two but for the narrower leaves of the former, which is said to differ also by the suberect—not patent—utricles; the specimens are not fully ripe and the degree of reflexion of the utricles

depends upon maturity. KÜKENTHAL placed *C. subtransversa* under *C. brownii* and its var. *transversa* (BOOTT) KÜK., with which it is certainly not closely related.

43. *Carex brownii* TUCKERM. En. Meth. Car. (1843) 21 (or 15? '*brownii*'?); BOOTT, Ill. 4 (1867) 161, t. 532 (*pl. dextrae*); BOECK. Linnaea 41 (1877) 151, incl. var. *viridis* BOECK.; BENTH. Fl. Austr. 7 (1878) 447; KÜK. Pfl. R. Heft 38 (1909) 612, f. 104 A–D; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 477; S. T. BLAKE, J. Arn. Arb. 28 (1947) 115; NELMES, Kew Bull. (1949) 384; Reinwardtia 1 (1951) 398; KOYAMA, Act. Phytotax. Geobot. 18 (1959) 23; J. Fac. Sc. Un. Tokyo III, 8 (1962) 215; Phytologia 17 (1968) 409, t. 16. — *C. striata* R. BR. Prod. (1810) 243; KUNTH, En. 2 (1837) 458; STEUD. Syn. 2 (1855) 226; DREJER, Symb. Caric. (1844) 28, t. 15; non MICHX, 1803. — *C. nipposinica* OHWI, Act. Phytotax. Geobot. 11 (1942) 255; AKIYAMA, Car. Far East. Reg. Asia (1955) 144, t. 133; YOSHIKAWA, Ic. Jap. Carex 2 (1958) 256, t. 128.

a. *ssp. brownii*. — Fig. 122.

Rhizome short, without stolons. Stems slender, erect, triquetrous, smooth or almost so, 25–75 cm by 1–1½ mm. Leaves basal and often 1 higher up the stem, flat, weak, shorter than the stems, long-acuminate, scabrous on nerves and margins, 3–4 mm wide, lowest ones reduced to bladeless, reddish-brown sheaths. Spikelets 3–4(–5), erect, short-cylindric to cylindric, upper approximate, fastigate, lowest often more or less distant; terminal spikelet ♂, or rarely gynaeandrous, subsessile, pale, (½)–1–2½ cm by 2(–3) mm; lateral spikelets ♀, subsessile or lowest sometimes on a long, exserted peduncle, short-cylindric, obtuse, densely flowered, 1½–2½(–3) cm by 5–6 mm. Lowest bract foliaceous, overtopping the inflorescence, more or less sheathing, upper much shorter, not or hardly exceeding the inflorescence. Glumes ovate or oblong-ovate, obtuse, scarious, 1–2 mm long, whitish with 3-nerved green central stripe excurrent in a scabrous, ½–3½ mm long awn. Utricles broadly ellipsoid to subglobose, obscurely trigonous, inflated, membranous, strongly many-ribbed, glabrous, straight, patent, dark olive-green to dark brown, contrasted against the white glumes, 3–4 by 1⅓–1¾ mm, suddenly contracted into a very short, bidenticulate beak. Nut obovoid, triquetrous, yellowish, 2¼–2½ by 1⅓–1½ mm, with a very short, (sometimes indistinctly) bent stipe and beak. Style-base slightly thickened. Stigmas 3.

Distr. Japan, Korea, Formosa, E. China (Yangtze R. valley), Australia (New South Wales, Victoria), New Zealand; in Malesia: New Guinea (W. New Guinea: Balim R. valley; Terr. of New Guinea: W. Highlands, lower Tale valley and



Fig. 131. Inflorescence (nat. size), spikelets and (occasionally) venation ( $\times 2$ ). — 48. *Carex michauxiana* BOECK., a. — 18b. *C. perakensis* CLARKE var. *borneensis* (CLARKE) NOOT., b. — 18a. var. *perakensis*, c-d. — 19a. *C. turrita* CLARKE var. *turrita*, e-f. — 50. *C. maubertiana* BOOTT, g. — 64. *C. echinata* MURR., h. — 15. *C. baccans* NEES, i. — 51. *C. graeffeana* BOECK., j (a SCHODDE 1992, b BROOKE 8561, c-d VAN STEENIS 8277, e-f ANU 15532, g KOSTERMANS 14005, h DE WILDE c.s. 13323, i ELBERT 62, j SINCLAIR 979?).





Fig. 132. Glumes,  $\times 10$ . — 46. *Carex brachyathera* OHWI, a. — 49. *C. pseudocyperus* L. var. *fascicularis* (SOLAND. ex BOOTT) BOOTT, b. — 52. *C. phacota* SPRENG., c. — 53. *C. pruinosa* BOOTT, d. — 54. *C. teres* BOOTT, e. — 56. *C. bilateralis* HAYATA, f. — 57. *C. brunnea* THUNB., g (a BRASS 9803, b EYMA 4709, c JERMY 4634, d VAN STEENIS 4624, e DE WILDE c.s. 13329, f BRASS 9515, g EYMA 3862).

Sirunki; E. Highlands, Aiyura, and Kainantu, Morobe Distr., Langiman R.). Distr. map in Acta Phytotax. Geobot. 18 (1959) 24.

Ecol. In wet places, pools, drains, etc., also open grassy area; 1500–2500 m.

Vern. *Kariandend*, Enga lang.

b. *ssp. transversa* (BOOTT) KERN, *stat. nov.* — *C. transversa* BOOTT, Perry Exp. 2 (1857) 324; Ill. 4 (1867) 202; FRANCH. & SAV. En. Pl. Jap. 2 (1879) 149, *incl. var. dissociata* FRANCH. & SAV.; FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris III, 10 (1898) 48, t. 3, f. 1; CLARKE, J. Linn. Soc. Bot. 36 (1904) 314; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 478; AKIYAMA, Car. Far East. Reg. Asia (1955) 145, t. 134; YOSHIKAWA, Ic. Jap. Carex 2 (1958) 258, t. 129. — *C. brownii* var. *transversa* KÜK. ex MATSUM. Index Pl. Jap. 2 (1905) 103; KÜK. Pfl. R. Heft 38 (1909) 614. — *C. furusei* KOYAMA, J. Jap. Bot. 30 (1955) 135, *pro C. brownii*  $\times$  *transversa*. — *C. brownii* var. *dissociata* KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 215. — Fig. 122.

Utricles ovoid-ellipsoid, up to 6 mm long, gradually narrowed into a c. 2 mm long beak.

Distr. Japan, Ryu Kyu Is., Korea, China (Yangtze valley region); in *Malesia*: New Guinea (W. Highlands, Sirunki).

Ecol. In New Guinea near water-course on clay soil, at c. 2500 m.

Note. The long-beaked utricles are so different from those of *C. brownii* s.s., that I prefer to treat this taxon as a subspecies, not as a variety of *C. brownii*.

44. *Carex oedorrhampha* NELMES, Kew Bull. (1939) 659; *ibid.* (1949) 384; Reinwardtia 1 (1951) 396; *ibid.* 2 (1954) 381; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 83; Dansk Bot. Ark. 23 (1965) 261; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 490. — *C. tumida* BOOTT, Ill. 1 (1858) 66, t. 181; BOECK. Linnaea 41 (1877) 243; CLARKE, Fl. Br. Ind. 6 (1894) 741; J. Linn. Soc. Bot. 37 (1904) 16; KÜK. Pfl. R. Heft 38 (1909) 615; Bull. Jard. Bot. Btzg III, 16 (1940) 321, *non* BEILSCHM. 1850. — *C. olivacea* (non BOOTT) KÜK. Bot. Jahrb. 70 (Jan. 1940) 467; Bull. Jard. Bot. Btzg III, 16 (Feb. 1940) 321, *incl. var. altissima* KÜK.; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 70, *p.p.* — *C. oedorrhampha* var. *arfakiana* OHWI, Bot. Mag. Tokyo 56 (1942) 214. — *C. oedorrhampha* var. *microcarya* NELMES, Kew Bull. (1950) 204; Reinwardtia 1 (1951) 398. — Fig. 122.

Rhizome short, in large tussocks, without stolons. Stems tufted, slender, erect, triquetrous, smooth, 50–125 cm by 2–3 mm below. Leaves subbasal and 1–2 higher up the stem, about as long as the stem, flat, stiffish, long-acuminate, scabrous on margins and main nerves, 4–8 mm wide, few lowest reduced to reddish purple sheaths readily fraying into thin strips; ligula elongate, up to 1½ cm long. Spikelets 4–6, erect or subcernuous, upper approximate and fastigate, lower distant; terminal spikelet ♂, long-linear, subsessile, not or slightly exceeding the uppermost lateral spikelet, pale, 2–6 cm long, 1–2 mm thick, lateral spikelets ♀, narrowly cylindric, densely flowered, 2½–12 cm long, 4–6 mm thick, upper on shortly, lower on long-exserted, scabrid peduncles. Lower bracts

foliaceous, much exceeding the inflorescence, long-sheathing, upper more or less reduced. *Glumes* oblong to ovate-lanceolate, obtuse, translucent, glabrous or sparsely hispidulous,  $1\frac{3}{4}$ –2 mm long, whitish with 3-nerved, green, central stripe excurrent in a scabrid awn 1–2 mm long. *Utricles* ellipsoid, membranous, somewhat inflated, pluri-nerved, glabrous, obliquely erect to subpatent, olive-brown to fuscous,  $3\text{--}3\frac{3}{4}$  by  $1\text{--}1\frac{1}{2}$  mm, rather gradually narrowed into a  $1\text{--}1\frac{1}{2}$  mm long, conic-linear, smooth, minutely notched beak which is often somewhat swollen at or below the middle. *Nut* ellipsoid, triquetrous, yellow to brownish, shortly stipitate, distinctly beaked,  $(1\frac{1}{2}\text{--})2\text{--}2\frac{1}{4}$  by c. 1 mm. *Style* straight, thickened at the base. *Stigmas* 3.

Distr. E. Himalaya, S. China (Yunnan), N. Thailand, Tonkin, Assam; in *Malesia*: Sumatra (Atjeh; W. Coast Res.: Mt Kerintji), W. Java (Mt Papandajan), Moluccas (Buru), New Guinea.

Ecol. Wet places in forests, lake margins, swampy grasslands, 1200–2400 m.

Notes. BOOTT's figure, showing a distinct swelling in the middle of the beak (hence his specific epithet) is, according to CLARKE, taken from a not fully ripe collection. In mature utricles the lower half of the beak is cylindric, somewhat swollen, the upper conic. In the specimens from Mt Kerintji the beak is scarcely swollen; they were distinguished as *var. microcarya* NELMES.

Besides to *C. olivacea* the species is closely related to *C. ischnostachya* STEUD. from Japan, which is easily distinguishable by the muticous glumes, but otherwise very similar.



Fig. 133. *Carex olivacea* BOOTT in the Kerintji area, Westcoast of Sumatra, Rawal Bento, 1400 m altitude (MEIJER 6656, Aug. 1956).

45. *Carex olivacea* BOOTT, Proc. Linn. Soc. 1 (1846) 286; Ill. 1 (1858) 56, t. 149; CLARKE, Fl. Br. Ind. 6 (1894) 741; J. Linn. Soc. Bot. 37 (1904) 15; KÜK. Pfl. R. Heft 38 (1909) 617; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 70, p.p.; NELMES, Reinwardtia 1 (1951) 395; KOYAMA, Bot. Mag. Tokyo 72 (1959) 304; J. Fac. Sc. Un. Tokyo III, 8 (1962) 215; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 490.

*ssp. olivacea*. — Fig. 122, 133.

Rhizome stout, woody, emitting long, stout stolons. *Stems* stout, erect, triquetrous, smooth or scabrid on the angles above, 50–110 cm by up to 5 mm below. *Leaves* basal and subbasal, much exceeding the stems, flat, stiffish, long-acuminate, scabrous on the margins towards the top, the broader ones 1–2 cm wide; sheaths stramineous, somewhat spongy, deeply concave in front, ligule elongate, up to 5 cm long. *Spikelets* 4–9 (according to BOOTT up to 14), erect, long-cylindric, upper approximate, fastigiate, lower somewhat distant; terminal spikelet ♂ (often with some ♀ flowers at the base), peduncled,  $5\frac{1}{2}$ –16 cm long and 5 mm thick, often a second, shorter ♂ spikelet added at



the base, remaining spikelets ♀ (but usually with short ♂ apices), very densely flowered, sessile but lowest sometimes distinctly peduncled, up to 16 cm by 5–8 mm. Lower bracts foliaceous, much overtopping the inflorescence, semi-amplexicaul by dark auricles, upper shorter, usually none sheathing (lowest sometimes more or less sheathing). *Glumes* oblong, obtuse, vinaceous to dark red with 3-nerved, green,  $1\frac{1}{4}$ –3 mm long, central stripe excurrent in a scabrid awn  $\frac{3}{4}$ –3 mm long. *Utricles* obovoid or ellipsoid, membranous, much inflated when ripe, rugose when dry, slenderly plurinerved, patent or reflexed, glabrous, olive-brown,  $3\frac{1}{2}$ – $4\frac{2}{3}$  by  $1\frac{1}{2}$ –2 mm, suddenly narrowed into a short, conic, often recurved, minutely bidenticulate beak ciliate at the mouth. *Nut* obovoid or oblong-obovoid, triquetrous, beaked, stramineous to yellowish, c. 2 by 1 mm. *Style* straight, not or hardly thickened at the base. Stigmas 3.

Distr. NE. India; in *Malesia*: W. Sumatra (Mt Kerintji), W. Java (Telaga Bodas, once collected by H. O. FORBES in 1880). The record for

Indo-China (Reinwardtia 1, 1951, 396) refers to a collection of *C. nemostachya* STEUD. Distr. map in Bot. Mag. Tokyo 72 (1959) 304, f. 26 (the occurrence in Java erroneously indicated as comprising the whole western and central part of that island, the Sumatran locality unknown at the time).

Ecol. On Mt Kerintji in swamp at 1400 m altitude, at Telaga (= lake) Bodas "in warm water, 1500 m."

Notes. Closely related to 44. *C. oedorrhapha* NELMES, but much stouter, and distinguished from all other members of its section by its very wide leaves and very long spikelets.

*Ssp. confertiflora* (BOOTT) KOYAMA, Bot. Mag. Tokyo 72 (1959) 307; Phytologia 17 (1968) 413, t. 17 (*C. confertiflora* BOOTT in A. Gray, Bot. Jap. 1859, 418; Ill. 4, 1867, 184; *C. olivacea* var. *minor* KÜK. Pfl. R. Heft 38, 1909, 618), from Japan, and *ssp. recurvisaccus* (KOYAMA) KOYAMA, l.c. (*C. recurvisaccus* KOYAMA, J. Jap. Bot. 15, 1956, 166, f. 2), from China, Kwantung, differ but slightly from the typical subspecies.

### 17. Section Ferrugineae

[TUCKERM. En. Meth. (1843) 12, *nomen*]; *ex* BAILEY, Proc. Am. Ac. 22 (1886) 92, as group; NELMES, Reinwardtia 1 (1951) 409. — *Sect. Frigidiae* FRIES *subsect. Ferrugineae* (BAILEY) KÜK. Pfl. R. Heft 38 (1909) 559.

Type species: *Carex ferruginea* SCOP.

46. *Carex brachyathera* OHWI, Jap. J. Bot. 7 (1934) 190; Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 332, f. 4, t. 8 f. 5; AKIYAMA, Car. Far East. Reg. Asia (1955) 133, t. 118; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 158, *incl. var. brevispiculosa* KOYAMA. — *C. breviculmis* var. *perciliata* (non KÜK.) RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 247. — *C. tricuspidata* KÜK. Bot. Jahrb. 70 (1940) 466, *incl. var. brevispiculosa* KÜK. *et* var. *minor* KÜK.; S. T. BLAKE, J. Arn. Arb. 28 (1947) 113; NELMES, Kew Bull. (1949) 384; Reinwardtia 1 (1951) 410. — Fig. 122, 132a.

Rhizome thick, woody, obliquely descending, sometimes elongated. *Stems* erect, somewhat cernuous at the top, triquetrous, smooth or slightly scaberulous just below the inflorescence, (5–)20–70 cm by 1–1½ mm, at the base covered with a thick mass of fibrous, brownish remains of leaf-sheaths. *Leaves* basal or 1–2 higher on the stem, shorter than the stem, flat, or involute when dry, stiffish, asperous, long-attenuate, 1–3½ mm wide. *Spikelets* 3–5, single at the nodes, erect to cernuous, often subfastigate, rather densely flowered above, lax-flowered below, 1½–6 cm long, terminal one ♂, subclavate, 1–2 mm thick, long-peduncled, lateral ones ♀, linear-cylindric, 2½–3½ mm thick, on exserted, slender, smooth or antrorsely scabrid

peduncles. Lower bracts foliaceous, shorter to slightly longer than their spikelet, long-sheathing, upper reduced. *Glumes* oblong, often asymmetrical, truncate or emarginate, thin, brown, whitish hyaline at the top, 3–4½ mm long, with strong midrib excurrent in a hispidulous, up to 1 mm long awn. *Utricles* ellipsoid or ellipsoid-fusiform, obtusely compressed-trigonous, angled ventrally, membranous, nerveless except for 2 submarginal nerves, sparsely to rather densely subappressed-hispid, suberect, stipitate, 3–4½ by c. 1 mm, rather gradually narrowed into a stout, straight or slightly bent, bidentate, 1–1½ mm long beak with oblique, white-hyaline mouth. *Nut* ellipsoid, triquetrous, c. 2 by 1 mm. *Style-base* pyramidally thickened. Stigmas 3 (according to NELMES 2 or 3).

Distr. Ryu Kyu Is., Formosa; in *Malesia*: New Guinea (Mt Carstensz, Mt Wilhelmina in W., Mt Sarawaket in E.).

Ecol. In mountain grasslands, on steep rocks, seepages, sandy margins of streams, 3000–4000 m.

Notes. The New Guinea collections exhibit a high degree of variability in size, length of bracts, spikelets, and utricles, probably due to their growing at high altitude, often in uncongenial habitats. I do not see any reason to treat them as varietally distinct from the Formosan plants, as was

done by KOYAMA, on account of the longer bracts and — according to NERMES — sometimes digynous flowers.

To judge from its description and excellent

figure, *C. drepanorhyncha* FRANCH. Pl. David. 2 (1888) 141; Nouv. Arch. Mus. Hist. Nat. Paris III, 9 (1897) 178, t. 4, f. 1; KÜK. Pfl. R. Heft 38 (1909) 563, from Szechuan, is very near to *C. brachyathera*.

### 18. Section Sylvaticae

[TUCKERM. En. Meth. (1843) 12, *nomen*]; BOOTT *ex* MACKENZ. N. Am. Fl. 18 (1935) 283; NERMES, Reinwardtia 1 (1951) 402. — *Sect. Hymenochlaenae* DREJER *subsect. Debiles* (CAREY) KÜK. Pfl. R. Heft 38 (1909) 594, p.p.

Type species: *Carex sylvatica* HUDS.

47. *Carex finitima* BOOTT, Ill. 1 (1858) 44, t. 112; BOECK. Linnaea 41 (1877) 247; CLARKE, Fl. Br. Ind. 6 (1894) 736; KÜK. Pfl. R. Heft 38 (1909) 598, f. 101 E-H; NERMES, Kew Bull. (1949) 385, 391; *ibid.* (1950) 204; Reinwardtia 1 (1951) 403; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 218. — *C. remotiflora* HAYATA, Ic. Pl. Form. 10 (1921) 68, f. 45; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 446; AKIYAMA, Car. Far East. Reg. Asia (1955) 155, t. 148, f. 2. — *C. fusiformis* NEES *var. enervosa* KÜK. Bot. Jahrb. 70 (1940) 467. — *C. atjehensis* KÜK. Bull. Jard. Bot. Btzg III, 16 (1940) 314; in Fedde, Rep. 53 (1944) 105 ('*atjehensis*'). — Fig. 122.

Rhizome short. *Stems* tufted, erect, triquetrous, smooth, (10-)30-90 cm by 1-2 mm below, surrounded below the leaves by a few reddish bladeless sheaths. *Leaves* basal and 1-2 higher up the stem, shorter than to slightly exceeding the stem, flat, smooth except for the minutely scaberulous margins, long-attenuate, 2-8 mm wide. *Spikelets* 4-8(-12 according to BOOTT), linear-cylindric, terminal one ♂ or rarely gynaeandrous, peduncled, 1½-4½ cm by c. 1 mm (sometimes a smaller second ♂ spikelet added), remaining ones ♀, lax-flowered, erect or lower cernuous, upper approxi-

mate, lower remote, 2-9 cm by 3-7 mm; peduncles very slender, smooth or sparsely scaberulous above, lower long-exserted. Lower bracts foliaceous, slightly shorter than to much exceeding the inflorescence, long-sheathing, upper much reduced; sheaths pale to reddish brown. *Glumes* oblong-ovate, acute to very obtuse, 3½-4(-6) mm long, translucent, with broad, white margins and greenish midrib, the latter not reaching the apex but sometimes excurrent below the apex in a short, up to 1(-2) mm long awn. *Utricles* fusiform, trigonous, membranous, with 2 marginal nerves, otherwise nerveless or obscurely few-nerved, glabrous, smooth, obliquely erect, shining, light green, 5-7½ by 1-2 mm, rather gradually narrowed into a linear-cylindric, long, smooth beak with oblique, scarious mouth. *Nut* ellipsoid or oblong-ellipsoid, triquetrous, finally dark brown, shortly stipitate, abruptly beaked, 2¼-3 by 1-1½ mm. *Style* thickened at the base. *Stigmas* 3, long, slender.

Distr. E. Himalaya, S. China (Szechuan, Yunnan), Formosa; in *Malesia*: N. Sumatra (Atjeh: Gajolands), E. New Guinea.

Ecol. Grassy and bushy slopes, alpine grasslands, 2400-3900 m.

### 19. Section Folliculatae

MACKENZ. in Britt. & Brown, Ill. Fl. ed. 2, 1 (1913) 353; N. Am. Fl. 18 (1935) 426. — *Sect. Orthocerates* KOCH *subsect. Folliculatae* (MACKENZ.) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 234.

Type species: *Carex folliculata* L.

48. *Carex michauxiana* BOECK. Linnaea 41 (1877) 336; CLARKE, J. Linn. Soc. Bot. 36 (1904) 298; KÜK. Pfl. R. Heft 38 (1909) 705; MACKENZ. N. Am. Fl. 18 (1935) 427; N. Am. Car. 2 (1940) t. 489; FERN. in Gray's Man. Bot. ed. 8 (1950) 375, f. 742; GLEASON, New Britt. & Brown Ill. Fl. 1 (1952) 358 f. — *C. rostrata* MICHX. Fl. Bor.-Am. 2 (1803) 173; BOOTT, Ill. 2 (1860) 91, t. 267; *non*

STOKES, 1787. — *C. abacta* L. H. BAILEY, Bull. Torr. Bot. Club 20 (1893) 427.

The Asiatic plants are distinguished as:

*var. asiatica* (HULTÉN) OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 491; AKIYAMA, Car. Far East. Reg. Asia (1955) 163, t. 158 f. 2; YOSHIKAWA, Ic. Jap. Carex 2 (1958) 268, t. 134; KOYAMA,



J. Fac. Sc. Un. Tokyo III, 8 (1962) 235; KERN, Blumea 13 (1965) 125. — *C. michauxiana* ssp. *asiatica* HULTÉN, Kungl. Svenska Vet. Ak. Handl. 5 (1927) 207, f. 14, t. 223; Phytologia 17 (1968) 417, t. 19. — *C. michauxiana* f. *asiatica* (HULTÉN) AKIYAMA, J. Fac. Sc. Hokkaido Imp. Un. 5 (1932) 220, f. 162. — *C. dolichocarpa* C. A. MEY. ex KREZ. in Komar. Fl. U.R.S.S. 3 (1935) 458, 623. — Fig. 122, 131a.

Rhizome short, thick. *Stems* densely tufted, stiffly erect, slender, trigonous, smooth, at the base clothed with the remains of old leaf-sheaths, 20–60 cm by 1–2 mm. *Leaves* subbasal, shorter to longer than the stems, firm, flat, long-attenuate, scabrid towards the apex, light green, 2–5 mm wide; sheaths tight, white-hyaline ventrally, ligule as long as wide. *Inflorescence* consisting of 1 terminal ♂ spikelet and (1–)2–4 ♀ spikelets. Bracts long-sheathing, leaf-like, the lower overtopping the inflorescence; sheaths concave at the mouth. ♂ *Spikelet* (see note) shortly peduncled or subsessile, few-flowered, 8–20 by  $1\frac{1}{2}$ –2 $\frac{1}{2}$  mm; glumes oblong-ovate, acute, yellowish brown with 3-nerved green centre and hyaline margins; upper ♀ spikelets subsessile, crowded and sometimes hiding the ♂ one (see note), the lower 1–2 remote, on slender, more or less exserted, erect, smooth peduncles, subglobose or broadly ovoid, 5–20-flowered, 15–25 mm long and wide. *Glumes* ovate, acutish, hyaline with conspicuously 4–5-nerved centre,  $\frac{1}{3}$ – $\frac{1}{2}$  as long as the utricles. *Utricles* at first appressed-ascending, soon divergent, lanceolate-subulate, obtusely trigonous, subcoriaceous, glabrous, many-nerved, stipitate, spongy at the base,

shining yellowish green, (8–)12–13 by  $1\frac{1}{2}$ –2 mm, gradually tapering into the scabrid bidentate beak; teeth erect,  $\frac{2}{3}$  mm. *Nut* trigonous with convex sides, oblong-ovoid, shortly stipitate, shining yellow, c. 3 by  $1\frac{1}{2}$  mm. *Style* continuous with the nut, tortuous, subincrassate at the base. Stigmas 3.

*Distr.* The typical variety in northeastern N. America, the var. *asiatica* in eastern Asia: S. Kamchatka, Kuriles, Yezo, Hondo, China (Shanghai); in *Malesia*: E. New Guinea.

*Ecol.* In swamps, bog grasslands, 2250–2650 m.

*Vern.* *Tudik*, Mendi lang., *koale*, Enga lang.

*Notes.* The differences between the American plants and the Asiatic ones are but slight, and it is questionable whether recognition of two geographical races is justified. In the few American specimens I could examine the ♂ spikelet does not overtop the upper ♀ ones (but this is not rarely also the case in Asiatic specimens!), the leaves are slightly narrower (2–3 mm wide), the ♀ glumes 3-nerved, and the utricles in general somewhat smaller. I fail to see the difference in the relative length of the glumes mentioned by KOYAMA. If the detailed description by MACKENZIE, *l.c.*, refers to American plants only, the distinction of two varieties seems unjustified, as the Asiatic plants almost completely fall within the limits of variation there given.

It is worth noticing that most of the terminal spikelets in the Mt Giluwe specimens are not strictly ♂, but bear some ♀ flowers at the top. Sometimes the ♂ spikelet is either inconspicuous or absent.

A northern element in the New Guinea mountain flora.

## 20. Section *Pseudocyperae*

[TUCKERM. En. Meth. (1843) 13, *nomen*]; ex BAILEY, Proc. Am. Ac. 22 (1886) 69, as group; KÜK. Pfl. R. Heft 38 (1909) 693. — *Sect. Orthocerates* KOCH *subsect. Pseudocyperae* (BAILEY) KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 234.

*Type species: Carex pseudocyperus* L.

49. *Carex pseudocyperus* LINNÉ, Sp. Pl. 2 (1753) 978; BOOTT, Ill. 4 (1867) t. 451, 452; BOECK. Linnaea 41 (1877) 321; KÜK. Pfl. R. Heft 38 (1909) 695.

In *Malesia* only:

var. *fascicularis* (SOLAND. ex BOOTT) BOOTT, Ill. 4 (1867) 41; KÜK. Pfl. R. Heft 38 (1909) 696; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 234; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 490. — *C. fascicularis* SOLAND. ex BOOTT in Hook. f. Fl. Nov. Zel. 1 (1853) 283; BOOTT, Ill. 1 (1858) 53, t. 139, 140; S. T. BLAKE, J. Arn. Arb. 28 (1947) 116; NELMES, Reinwardtia 1 (1951) 393. — *C. pseudocyperus* (non L.) R. BR. Prod. (1810) 243;

BENTH. Fl. Austr. 7 (1878) 448; CLARKE, J. Linn. Soc. Bot. 37 (1904) 16. — Fig. 122, 132b.

Rhizome very short, woody. *Stems* stout, tufted, erect, triquetrous with flat or slightly concave sides, smooth except just below the inflorescence, surrounded below the leaves by a few bladeless, somewhat fibrous sheaths, 50–150 cm by 3–4 mm. *Leaves* subbasal, longer than the stems, flat, stiffish, rough-margined, conspicuously septate-nodulose, long-acuminate, light or yellowish green, 6–10 mm wide. *Spikelets* 3–7, usually close together (lowest 1–2 sometimes distant), the terminal ♂, peduncled, 3–7 mm thick, the lateral ♀, cylindrical, very densely flowered, 2 $\frac{1}{2}$ –5 cm long and 7–15 mm thick, the upper shortly peduncled, the lower on slender,

smooth or scabrid peduncles at length pendulous. Lower bracts leaf-like, far exceeding the inflorescence, scarcely sheathing (occasionally long-sheathing in distant spikelets), upper subfoliaceous to setaceous, not sheathing. *Glumes* oblong or oblong-spathulate, obtuse, translucent, eventually ferruginous, with 3-nerved green centre, ciliate above, 2–2½ mm, excurrent into a flat, antrorsely scabrous awn 2–4 mm long. *Utricles* ovoid or ovoid-lanceolate, obscurely trigonous, strongly and densely many-nerved, coriaceous, glabrous, when ripe widely spreading or even reflexed, somewhat inflated, distinctly stipitate (stipe  $\frac{2}{3}$ –1 mm, in some Australian specimens up to 1½ mm), greenish to stramineous, 4–5(–7) by 1–1½ mm, tapering above into a 1½–2 mm long, smooth, deeply 2-cleft beak (teeth c. 1 mm, divergent). *Nut* obovoid or ellipsoid, triquetrous, scarcely stipitate, golden or brown, 1½–12/3 by 1(–1⅓) mm. *Style* continuous with the nut, contorted. Stigmas 3.

Distr. *Carex pseudocyperus* in the circumscription here accepted shows an almost worldwide distribution. The typical variety is widely distributed in the northern hemisphere (Eurasia

from W. Europe to Kashmir and Japan, N. Africa, eastern N. America). Other varieties occur in North and South America; *var. fascicularis* in Australia (Tasmania to Queensland) and in New Zealand, in Malesia: New Guinea (W. New Guinea; Lake Habbema, Wissel Lake region; Terr. of New Guinea: W. Highlands, Kandep valley; Yobobos grassland area; Lake Inin). Specimens of this variety in BM and K are labelled "Java, Horsfield"; recent collections from this island are not extant.

Ecol. In pools and swamps, along lakes, riversides; 1750–3225 m.

Vern. *Kwai'a'reh, koali*, Enga lang., Kepilam.

Notes. *Var. fascicularis* differs from *var. pseudocyperus* in its darker, ferruginous glumes, its subinflated utricles with more divergent teeth to their beaks and longer stipe, and its contorted style.

The varieties certainly represent geographical races and might therefore better be considered subspecies. They are often treated at specific level, but the differences are so slight that it is here preferred to follow BOOTT (1867) and KÜENTHAL (1909).

## 21. Section *Oclusae*

CLARKE, Kew Bull. add. ser. 8 (1908) 147; RAYM. Mém. Jard. Bot. Montréal *n.* 53 (1959) 55, 87; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 169. — *Sect. Scleriiculmes* NELMES, Kew Bull. (1951) 121; Reinwardtia 1 (1951) 407; KOYAMA, J. Jap. Bot. 29 (1954) 44; Act. Phytotax. Geobot. 16 (1955) 108.

Type species: *Carex maubertiana* BOOTT.

50. *Carex maubertiana* BOOTT, Ill. 1 (1858) 45, t. 114; CLARKE, J. Linn. Soc. Bot. 36 (1904) 297; CAMUS, Fl. Gén. I.-C. 7 (1922) 200, f. 29, 5–8; NELMES, Reinwardtia 1 (1951) 408; RAYM. Mém. Jard. Bot. Montréal *n.* 53 (1959) 87; KOYAMA, Act. Phytotax. Geobot. 16 (1955) 39; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 489. — *C. hebecarpa* C. A. MEY. *var. lachnosperma* CLARKE, Fl. Br. Ind. 6 (1894) 747, *quoad specim., non C. lachnosperma* NEES. — *C. hebecarpa var. maubertiana* FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris III, 10 (1898) 70; KÜK. Pfl. R. Heft 38 (1909) 745. — *C. hebecarpa var. ligulata* (non KÜK.) BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 69. — Fig. 122, 131g.

Rhizome very short. *Stems* tufted, erect, triquetrous, smooth, for the greater part hidden by the leaf-sheaths, 40–60 cm by 2–3 mm. *Leaves* of normal length only in the upper half of the stem, exceeding the inflorescence, flattish to strongly revolute, stiff, greyish green, asperous above towards the long-attenuated apices, 3–7 mm wide, merging above into the foliaceous lower bracts and below into short-bladed to bladeless, purplish,

rather tight sheaths; ligule obtuse, membranous, ferruginous. *Spikelets* 4–9, erect or suberect, cylindric, dense-flowered, 1½–4 cm long, upper approximate, fastigate, on included or shortly exerted peduncles, lower somewhat distant, on scarcely to long-exserted, scabrid peduncles; terminal spikelet ♂, 1–2 mm thick, sometimes a second, smaller ♂ spikelet added; remaining spikelets ♀, 4–6 mm thick. Lower bracts foliaceous, exceeding the inflorescence, their sheaths hispidulous especially near the mouth, upper much reduced. *Glumes* ovate, obtuse to acutish, transparent, glabrous or hispidulous at the top, pale with hyaline margins and 3-nerved, greenish central stripe, covered with resinous flecks and streaks, mucicous or mucronulate, 1½–2½ mm long. *Utricles* ellipsoid, trigonous, submembranous, obliquely patent, with 2 marginal nerves displaced on to the dorsal face, densely white-hispid, broadly stipitate, 3–3¾ by 1¼–1¾ mm, abruptly narrowed into a c. 1 mm long, bidentate, finally somewhat upcurved beak. *Nut* ellipsoid, triquetrous, c. 2 mm long. *Style-base* thickened. Stigmas 3.



Distr. Himalaya, Annam, China (Hupeh); in *Malesia*: Sumatra (Atjeh; W. Coast Res.: Mt Kerintji), W. and E. Java (Priangan; Besuki), E. Borneo (Berouw: Mt Ilas Mapulu), New Guinea

(Morobe Distr., near Bulolo). Distr. map in Act. Phytotax. Geobot. 16 (1955) 38.

Ecol. Primary forests, forest-borders, bushy slopes, 400–2100 m.

## 22. Section Longispicae

CLARKE, J. Linn. Soc. Bot. 37 (1904) 3; NELMES, Reinwardtia 1 (1951) 417.

Type species: *Carex graeffeana* BOECK.

51. *Carex graeffeana* BOECK. Flora 58 (1875) 123; CLARKE, J. Linn. Soc. Bot. 37 (1904) 5; Philip. J. Sc. 2 (1907) Bot. 107; KÜK. Pfl. R. Heft 38 (1909) 403; Philip. J. Sc. 6 (1911) Bot. 62; in Hochr. Candollea 6 (1936) 433; Bot. Jahrb. 69 (1938) 264; MERR. Philip. J. Sc. 5 (1910) Bot. 335; En. Philip. 1 (1923) 138; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 62; NELMES, Kew Bull. (1938) 109, incl. var. *samoensis* NELMES; *ibid.* (1955) 317; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 494; STEEN. Mt. Fl. Java (1972) pl. 14–9. — *C. rechingeri* PALLA, Oest. Bot. Z. 57 (1904) 424. — *C. philippinensis* NELMES, Kew Bull. (1938) 109; *ibid.* (1949) 385, 392; Reinwardtia 1 (1951) 419; *ibid.* 2 (1954) 381. — *C. exploratorum* NELMES, Kew Bull. (1938) 108; Reinwardtia 1 (1951) 418. — *C. pandanus* OHWI, Bot. Mag. Tokyo 56 (1942) 214. — *C. euphlebia* S. T. BLAKE, J. Arn. Arb. 28 (1947) 108, f. 3C. — Fig. 122, 131j.

Rhizome short, woody, forming large clumps. Stems densely tufted, stoutish, erect, triquetrous, scabrid on the angles at the top, 30–110 cm by up to 4 mm below, surrounded below the leaves by shining brown to blackish red sheaths splitting into herring-bone-shaped fibres. Leaves basal and subbasal, often 1–2 higher up the stem, stiff, subcoriaceous, flat but margins often revolute, scabrid on the nerves, long-attenuate, greyish or glaucous-green, much overtopping the stems, 3–12 mm wide. Bracts not sheathing, 2–3 lower ones foliaceous, semi-amplexicaul and blackish red auricled at the base, middle ones subfoliaceous, upper ones reduced to long-awned glumes. Spikelets (6–)10–15(–50), single or binate at the nodes, upper approximate, fastigate, subsessile, lower more distant, on capillary, scabrid, up to 5 cm long peduncles, more or less nodding, all androgynous or 1(–2) at the base of the uppermost much smaller and wholly ♂, exceptionally terminal spikelet wholly ♂, linear-cylindric, (3–)6–13 cm long, very densely flowered, the ♂ part occupying the upper  $\frac{1}{4}$ – $\frac{1}{2}$ , 1–3 mm thick, the ♀ part 4–6 mm thick. Glumes ovate or oblong-ovate, obtusish, purplish black, with wide, 3-nerved, greenish central stripe and very narrow hyaline margins,  $\frac{1}{2}$ – $2(-\frac{1}{2})$  mm long, excurrent in a hispid, short mucro sometimes 1 mm long. Utricles elliptic or obovate-elliptic, biconvex or plano-convex, multinerved, longer than (rarely about as long as) the glumes, finally divaricate, not stipitate, somewhat acuminate at the

top but scarcely beaked, often punctulate, sometimes minutely and sparsely setulose at the truncate or emarginate mouth,  $\frac{1}{2}$ – $2\frac{1}{2}$  by  $\frac{9}{10}$ – $1\frac{1}{4}$  mm. Nut elliptic or obovate, biconvex, brown,  $\frac{1}{2}$ – $1\frac{1}{4}$  by  $\frac{4}{5}$ – $1\frac{1}{4}$  mm. Style short, not thickened towards the base. Stigmas 2.

Distr. W. Polynesia (Samoa, Fiji Is.) and *Malesia*: New Guinea (incl. New Britain), Philippines (Luzon, Negros, Leyte, Mindanao), N. Borneo (Mt Kinabalu), Lesser Sunda Is. (Flores), W. Java (Mt Gedeh).

Ecol. On slopes in open places, on open banks of streams, in peaty alpine grasslands, and in mossy forest; on Mt Gedeh at 1600–1800 m, in the Philippines at 1500–2200 m (once collected at 400 m), on Mt Kinabalu at 1200 m, in New Guinea between 800 and 3800 m.

Vern. *Ilateum*, S; Philippines: *alagas*, Buk., *bagibi*, *giron*, Bag., *kigid*, Bon., *sidak*, *silak*, Ig.

Notes. NELMES (1938) distinguished between *C. graeffeana* (Fiji) with its var. *samoensis* (Samoa), *C. philippinensis* (Java, Philippines, New Guinea), and *C. exploratorum* (Borneo), mainly using width of leaves, number and length of spikelets, and size of utricles as specific characters. For the New Guinea specimens two more specific names are available, *C. pandanus* OHWI and *C. euphlebia* S. T. BLAKE. From NELMES's later publications it is clear that the characters used for discrimination are by far not so constant as was originally supposed. There is indeed considerable variation in the specimens collected in New Guinea or in the Philippines, and even in those from the only Javanese locality. The utricles are remarkably small in the Fiji specimens, but not in those from Samoa (the latter NELMES in 1955 no longer treated as variately distinct.) *Carex exploratorum* is only known from the type collection (Mt Kinabalu, CLEMENS 34297), in which the much compressed, sterile, and elongate utricles are apparently diseased. The few well-developed, nut-bearing utricles hardly differ from those of the other Malesian materials. The glumes are larger than usual, but not until more Kinabalu specimens are available will it be possible to judge of their taxonomical value.

On Mt Pulog (Luzon) the lower spikelets are often branched into a raceme of secondary spikelets, the total number of spikelets reaching up to c. 50.

23. Section *Praelongae*

(KÜK.) NELMES, Reinwardtia 1 (1951) 421; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 52, 55. — *Sect. Acutae* FRIES *subsect. Praelongae* KÜK. Pfl. R. Heft 38 (1909) 345.

Type species: *Carex praelonga* CLARKE.

**52. *Carex phacota* SPRENG.** Syst. 3 (1826) 826; NEES in Wight, Contr. (1834) 126; KUNTH, En. 2 (1837) 420; DREJER, Symb. Caric. (1844) 15, t. 4, *excl. syn. C. notha et C. punctata*; BOOTT, Ill. 1 (1858) 63, t. 168; BOECK. Linnaea 40 (1876) 434; CLARKE, Fl. Br. Ind. 6 (1894) 708; J. Linn. Soc. Bot. 37 (1904) 6 (*'phacodes'*); KÜK. Pfl. R. Heft 38 (1909) 350, f. 56A–C; Philip. J. Sc. 6 (1911) Bot. 62; MERR. En. Philip. 1 (1923) 140; KÜK. in Hochr. Candollea 6 (1936) 431; Bull. Jard. Bot. Btzg III, 16 (1940) 317; OHWI, Bot. Mag. Tokyo 56 (1942) 214; S. T. BLAKE, J. Arn. Arb. 28 (1947) 107; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 62; NELMES, Reinwardtia 1 (1951) 426; *ibid.* 2 (1954) 382; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 55; Dansk Bot. Ark. 23 (1965) 257; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 494; STEEN. Mt. Fl. Java (1972) 48a, pl. 14–7. — *C. lenticularis* D. DON, Trans. Linn. Soc. 14 (1824) 331; Prod. Fl. Nepal. (1825) 43; *non* MICHX. 1803. — *C. platycarpa* HOCHST. ex STEUD. Syn. 2 (1855) 214. — *C. hexasticha* REINW. ex MIQ. Fl. Ind. Bat. 3 (1857) 353, *p.p.* — *C. pruinosa* var. *aristata* O. K. Rev. Gen. Pl. 2 (1891) 748. — Fig. 122, 132c.

Rhizome short. Stems tufted, slender, erect, triquetrous, smooth or sparsely scaberulous just below the inflorescence, 20–120 cm by 1–3 mm, surrounded below the leaves by a few ferrugineous to dark brown, bladeless sheaths split into fine, sometimes reticulate fibres. Leaves subbasal and occasionally 1–2 higher up the stem, shorter to much longer than the stems, stiff, with strongly revolute margins, gradually attenuated, 3–8 mm wide. Spikelets 4–6, rarely more, subapproximate or the lowest more distant, cylindric, 2–8(–10) cm, terminal wholly ♂ or with a few ♀ flowers, erect, 1½–4½ mm thick, remainder androgynous (♂ part short) or wholly ♀, 4–6 mm thick, lower usually nodding on slender, smooth or scabrid, long peduncles. Lower bracts foliaceous, much overtopping the inflorescence, upper ones much smaller, none sheathing, but dark brown auricled at the base. Glumes oblong, obtuse, truncate, or bilobed-emarginate, thinly membranous, ferrugineous to castaneous, or pale with reddish flecks, 1¼–3 mm long, with 3-nerved central stripe excurrent in a wide, scaberulous-margined awn ½–2 mm long. Utricles elliptic, obovate, or suborbicular, compressed-biconvex, membranous, nerveless, narrowly marginate, glabrous, densely beset with ferrugineous or reddish, raised glandular papillae, obliquely erect, shortly stipitate, 2¼–3(–3½) by 1½–2¼ mm; beak extremely short,

entire. Nut pyriform to suborbicular, compressed-biconvex, broadly stipitate and beaked, 1¾–2 by 1¼–1¾ mm. Style thickened at the base. Stigmas 2.

Distr. Ceylon, Himalayan region, N. Thailand, S. & E. China, Korea, Formosa, Ryu Kyu Is., and Japan; in *Malesia*: Sumatra, Java, Lesser Sunda Is. (Flores), Philippines (Luzon), N. Celebes, and New Guinea.

Ecol. In open damp places, swampy grassland, 1500–2700 m.

On Mt Diëng (Java) VAN STEENIS (1972, *l.c.*) observed in the shallow crater marsh Telaga Panganon that it formed in a stand of *Scirpus mucronatus* L. large, solid, hummocky tussocks, 75 cm high and 50 cm thick, similar as do *C. paniculata* L. and the grass *Molinia caerulea* (L.) MOENCH. in Europe and *C. secta* BOOTT ('nigger-head') in New Zealand. This peculiar habit is obviously for a large part developing with a fluctuating water-level. — (Ed.)

Vern. New Guinea: *int*, *koole*, *kwajare*, Enga, *tsineme*, Mendi, *gogowe*, Kapauku, *yaguogufa*, Okapa, *tsiri ku*, Upper Kangel valley.

**53. *Carex pruinosa* BOOTT**, Proc. Linn. Soc. 1 (1845) 255; Trans. Linn. Soc. 20 (1846) 131; Ill. 1 (1858) 65, t. 174; STEUD. Syn. 2 (1855) 213; MIQ. Fl. Ind. Bat. 3 (1856) 352; CLARKE, Fl. Br. Ind. 6 (1894) 709; J. Linn. Soc. Bot. 34 (1898) 111; *ibid.* 37 (1904) 7, *excl. syn.*; KÜK. Pfl. R. Heft 38 (1909) 352; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 62, *excl. f. tristigmata* BACK.; NELMES, Reinwardtia 1 (1951) 428; KOYAMA, Bot. Mag. Tokyo 72 (1959) 300, 306; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 56; Dansk Bot. Ark. 23 (1965) 258; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 494. — *C. hexasticha* REINW. ex MIQ. Fl. Ind. Bat. 3 (1857) 353, *p.p.* — *C. pruinosa* f. *submutica* O. K. Rev. Gen. Pl. 2 (1891) 748. — Fig. 123, 132d.

Closely related to 52. *C. phacota* SPRENG., from which it is distinguished by the following characters:

Glumes lanceolate or elliptic, acute to obtusish (but not truncate-emarginate), muticous or (the lower ones) excurrent in a short awn up to 1 mm long. Utricles slightly larger, 3–4 mm long, dorsally slenderly 2–5-nerved, ventrally 1–3-nerved, the glandular papillae usually whitish. Spikelets more approximate, fastigiate, and suberect to subcenuous, ¾–5½ cm long. Leaves greyish green to glaucous, 2–6 mm wide; sheaths not splitting into fibres.

Distr. Assam, Annam, NE. Thailand; in *Malesia*: Java (West: several localities in Priangan;



Central: Diëng plateau; East: Jang plateau). In the Leyden Herbarium there is a sheet labelled "Sumatra, WAITZ", but WAITZ probably did not visit this island. See Fl. Males. I, 1 (1950) 554. KÜENTHAL's record for the Moluccas (Buru) refers to a collection of *C. phacota*; see there. The rather different *ssp. maximowiczii* (MIQ.) KÜK. (*C. maximowiczii* MIQ.) in Japan and Korea; see KOYAMA, l.c., with map.

Ecol. Swamps, damp grassy places, along streams, 1500–2500 m.

Notes. According to BACKER l.c., 52. *Carex phacota* and *C. pruinosa* would be connected by intermediates, but I have not seen any transitional forms and I find the two clearly distinct.

*Carex pruinosa f. tristigmatosa* BACK. belongs to 39. *C. maculata* BOOTT.

54. *Carex teres* BOOTT, Ill. 1 (1858) 62, t. 167, excl. *utriculo imo*; BOECK. Linnaea 40 (1876) 393; CLARKE, Fl. Br. Ind. 6 (1894) 707; J. Linn. Soc. Bot. 34 (1898) 110; KÜK. Pfl. R. Heft 38 (1909) 348; KERN in BACK. & Bakh. f. Fl. Java 3 (1968) 494. — *C. teres* var. *spatulata* KÜK. Bull. Jard. Bot. Btzg III, 16 (1940) 316. — *C. phacota* (non SPRENG.) KÜK. l.c. — *C. spatulata* NELMES, Kew Bull. (1950) 207; Reinwardtia 1 (1951) 423. — *C. kemiriensis* NELMES, Kew Bull. (1950) 206; Reinwardtia 1 (1951) 422. — *C. petecticalis* NELMES, Kew Bull. (1950) 205; Reinwardtia 1 (1951) 424. — Fig. 123, 132e.

Probably loosely tufted on a woody, ascending rhizome. *Stems* erect, stiff, triquetrous, smooth, 50–120 cm by 2–3 mm, at the base surrounded by bladeless to short-bladed, brownish to dark sheaths fraying into fine reticulate fibres. *Leaves* subbasal, crowded in the lower  $\frac{1}{3}$  of the stem, flattish with revolute margins, stiff, 4–7(–11) mm wide. *Spikelets* 4–8, cernuous, upper subapproximate, fastigate, lower more separated, gynaeceandrous usually with short ♂ base, or lower wholly ♀, cylindric, dense-flowered but often laxer at the base, 3–6(–8) cm long, the ♀ part 5–9 mm thick, the ♂ part 2–3(–5) mm, upper on short, lower on long, smooth peduncles. Lower bracts foliaceous, much to little exceeding the inflorescence, upper setaceous to glumiform, none sheathing but dark-auricled at the base. *Glumes* elliptic-oblong or oblong-obovate, subobtusely to very obtuse, truncate or bilobed,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long, dark red with wide, 3-nerved, pale central stripe excurrent in a flat, more or less

hispidulous awn up to  $1\frac{3}{4}$  mm long. *Utricles* ovate to elliptic, plano-convex, membranous, obscurely to distinctly 3–5-nerved on each face, straight, patulous, stramineous, usually densely covered with purplish flecks and minutely granular-punctulate, scarcely stipitate, gradually beaked, 3–4(– $4\frac{1}{2}$ ) by  $1\frac{1}{2}$ –2 mm; beak short,  $\frac{1}{2}$ – $\frac{3}{4}$  mm long, entire or slightly emarginate. *Nut* broadly elliptic or suborbicular, compressed-biconvex,  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm long, brown, shortly stipitate and beaked. *Style* slightly thickened at the base. Stigmas 2, short.

Distr. E. Himalaya; in *Malesia*: Sumatra (Atjeh: Mt Kemiri, Mt Losir, Senubong Mts; W. Coast: Mt Ophir, Mt Singgalang, Mt Kerintji), W. Java (Mt Papandajan).

I have not seen KERR 21031 from Laos, Pu Bia, the type collection of *C. kerrii* NELMES, Kew Bull. (1939) 304; *ibid.* (1946) 7, 28; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 175; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 56. From the description I infer that it is not specifically distinct from *C. teres*.

Ecol. In marshes, damp mountain meadows and heaths, in ericoid forest, in Sumatra between 2100 and 3500 m, in Java at 2300 m.

Notes. Variable, particularly as to the size of spikelets and utricles, and the nervation of the latter, but I do not see how to distinguish between the three "endemic species" into which NELMES split up the rather scanty Malesian materials. According to him *C. spatulata* differs from *C. teres* principally in its stouter and shorter spikelets, *C. petecticalis* from *C. spatulata* by its longer inflorescence (11–13 versus 7–10 cm), longer spikelets (3–6 versus 2– $4\frac{1}{2}$  cm), and shorter utricles ( $2\frac{3}{4}$ – $3\frac{1}{2}$  versus  $3\frac{1}{2}$ – $4\frac{1}{2}$  mm) with shorter beak. *Carex kemiriensis*, only known from a single collection, is said to differ by the densely papillose utricles, a difference I am unable to find.

KÜENTHAL thought the Sumatran and Javan plants to be varietally distinct from the continental Asian ones by the reticulate-fibrous basal sheaths, the shorter spikelets, the spatulate glumes, and slightly larger utricles. However, in the type collection of *C. teres* the basal sheaths are distinctly fibrous-reticulate and the glumes variable in shape, just like in the Malesian plants (see also BOOTT's figure!).

Provisionally I prefer to include both the Indian and Malesian materials in the variable *C. teres*, a mountain species with a broken-up area.

## 24. Section *Carex*

*Sect. Vulgares* (ASCHERS.) NELMES, Reinwardtia 1 (1951) 429.

Type species: *Carex acuta* (α) L.

55. *Carex gaudichaudiana* KUNTH, En. 2 (1837) 417; CLARKE, J. Linn. Soc. 37 (1904) 6; KÜK. Pfl. R. Heft 38 (1909) 312; Bot. Jahrb. 69 (1938) 264,

incl. var. *humilior* KÜK.; OHWI, Bot. Mag. Tokyo 56 (1942) 215; S. T. BLAKE, J. Arn. Arb. 28 (1947) 107; KOYAMA, Act. Phytotax. Geobot. 18 (1959)

22, f. 28. — *C. caespitosa* (non L.) R. BR. Prod. (1810) 243. — *C. vulgaris* FR. var. *gaudichaudiana* BOOTT, Ill. 4 (1867) 169, t. 567; BENTH. Fl. Austr. 7 (1878) 442. — *C. vulgaris* (non FR.) F.V.M. Fragm. 8 (1874) 257. — *C. lacerans* KÜK. Pfl. R. Heft 38 (1909) 326; NELMES, Kew Bull. (1949) 385, 392; Reinwardtia 1 (1951) 430. — Fig. 123.

Rhizome emitting short to rather long, horizontal stolons clothed with reddish, ribbed scales. Stems erect, triquetrous, scabrid above, 3–40 (–75) cm by 1–1½ mm. Leaves subbasal, often longer than the stem, somewhat rigid, flat or canaliculate, scabrid on the margins, 1½–4 mm wide, with involute margins when dry, the lower reduced to reddish to blackish red sheaths. Spikelets 3–6, approximate to rather distant, cylindric, terminal ♂, 1–4 cm by 2–3 mm, peduncled, sometimes a second smaller one immediately under it also ♂, remainder ♀ (or sometimes with a few ♂ flowers at the top), sessile or lowest very shortly peduncled, suberect, (1–)2–4(–6) by 3–4(–6) mm, densely flowered. Lower bracts foliaceous, usually overtopping the inflorescence, not sheathing, dark-aureoled at the base, upper much reduced. Glumes ovate or oblong-ovate, obtuse to rather acute, reddish to blackish red, with a central 3-nerved pale stripe, 2–3½ mm long, the midrib sometimes very shortly excurrent. Utricles elliptic, ovate, or ovate-lanceolate, compressed, plano-convex, obliquely erect, submembranous, strongly 5–7(–9)-nerved on the dorsal, 3–5-nerved on the ventral face, glabrous, green, becoming brownish, often minutely reddish-punctulate especially towards the apex, scarcely stipitate, subabruptly beaked,

2–3(–3½) by 1–1½ mm; beak short, entire or bidenticulate. Nut elliptic, obovate, or suborbicular, compressed, biconvex or plano-convex, shortly stipitate and apiculate, brown, 1½–2 mm long. Style not or scarcely thickened at the base. Stigmas 2.

Distr. Australia (Tasmania to Queensland) and New Zealand to E. China and Japan; in *Malesia*: throughout New Guinea. Distr. maps: DURIETZ, Act. Phytogeogr. Suec. 13 (1940) 219; KOYAMA, Act. Phytotax. Geobot. 18 (1959) 24.

Ecol. Open marshes, edges of lakes, marshy banks of streams, boggy alpine grasslands, 1450–3800 m.

Vern. New Guinea: *kwajare*, *lebandili*, Enga, *taua-tane*, Tari.

Notes. Very similar to *C. nigra* (L.) REICH., a common European and N. American species, and sharing with it an extreme polymorphism. *Carex gaudichaudiana* is characterized by the strongly nerved, more distinctly beaked utricles, and the lower bracts usually exceeding the terminal spikelet.

The type of *C. gaudichaudiana* is from Australia. The Asiatic plants have been distinguished as *var. thunbergii* (STEUD.) KÜK. Pfl. R. Heft 38 (1909) 313. — *C. thunbergii* STEUD. Flora 29 (1846) 23; Syn. 2 (1855) 221 (type from Japan).

The differences between the Australian plants and the Asiatic ones are but slight; see KOYAMA, *l.c.*

*Carex appendiculata* (TRAUTV.) KÜK. Pfl. R. Heft 38 (1909) 338 from E. Siberia, according to KOYAMA also only a variety of *C. gaudichaudiana*, is *C. nigra* (L.) REICH.

## 25. Section Graciles

[TUCKERM. En. Meth. (1843) 10]; *ex* KÜK. Bot. Jahrb. 27 (1899) 516, *quoad basion.*; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 464; NELMES, Reinwardtia 1 (1951) 353; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 52, 57; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 161. — *Sect. Hymenochlaenae* DREJER *subsect. Graciles* (KÜK.) KÜK. Pfl. R. Heft 38 (1909) 599.

Type species: *Carex gracilis* R. BR.

56. *Carex bilateralis* HAYATA, Mat. Fl. Form. (1911) 380; Ic. Pl. Form. 6 (1916) 127, f. 40 e–i; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 471, p.p.; AKIYAMA, Car. Far East. Reg. Asia (1955) 105, t. 84, f. 2; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 163. — *C. subteinogyna* OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 469, f. 17 & t. 15, f. 22; AKIYAMA, Car. Far East. Reg. Asia (1955) 102. — *C. spathaceo-bracteata* KÜK. Bot. Jahrb. 70 (1940) 466; NELMES, Reinwardtia 1 (1951) 356. — *C. acrophila* S. T. BLAKE, J. Arn. Arb. 28 (1947) 114; NELMES, Kew Bull. (1949) 382; Reinwardtia 1 (1951) 354. — *C. asperinervis* KOYAMA, Act. Phytotax. Geobot. 16 (1955) 6, t. 3,

f. U–V & f. W (*ut C. subteinogyna*). — Fig. 123, 132f.

Rhizome very short, woody. Stems tufted, slender, erect, trigonous, smooth except on the angles above, 20–90 cm by ¾–1½ mm, surrounded below the leaves by shining, fuscous to blackish, bladeless sheaths tending to split in front into reticulate fibres. Leaves shorter to longer than the stems, rigid, conduplicate, keeled, often flexuous at the long-attenuate top, scabrid, 1–2½ mm wide when flattened out. Inflorescence with 4–6 fascicles of (1–)2–3(–5) spikelets, narrow, 5–15 cm long; fascicles approximate or lower somewhat distant. Spikelets erect (or some possibly slightly cernuous),



linear-cylindric, simple, rather densely flowered, androgynous (♀ part considerably longer than to subequalling the ♂ part), 1–4 cm long, upper sessile or subsessile on included peduncles, lower on included to long-exserted, smooth or scaberulous peduncles. Lower bracts setaceous, shorter to longer than their fascicles but usually much shorter than the inflorescence, suddenly widening into a spathaceous, strongly nerved, reddish brown base with membranous margins clasping the base of the spikelets, with amplate, short or long sheaths; upper bracts much reduced. *Glumes* slightly shorter than utricles, oblong-lanceolate, acute to very obtuse, translucent, glabrous or very sparsely hispidulous on the midrib towards the apex, 3-nerved in the centre, ferruginous to fuscous with rather wide, whitish-hyaline margins, muticous or apiculate, 4–6 mm long. *Utricles* narrowly elliptic, plano-convex (occasionally trigonous), membranous, slenderly multinerved, suberect, reddish brown, whitish-hispidulous on the margins in the upper half and often on the nerves,  $3\frac{1}{2}$ – $5\frac{1}{2}$  (– $6\frac{1}{4}$ ) by 1– $1\frac{1}{2}$  mm, contracted below into a stout, stipe-like base  $\frac{1}{2}$ –1 mm long, rather gradually narrowed into a bidenticulate,  $1\frac{1}{4}$ – $1\frac{3}{4}$  mm long beak. *Nut* elliptic, oblong-elliptic, or oblong-obovate, compressed-biconvex (occasionally trigonous), not stipitate, shortly beaked, brown,  $1\frac{3}{4}$ – $2\frac{1}{4}$  by 1– $1\frac{1}{3}$  mm. *Style-base* slightly thickened. *Stigmas* 2 (occasionally 3), 3–7 mm long.

*Distr. Malesia:* New Guinea (Carstensz Mts, Lake Habbema, Mt Wilhelmia, Star Mts in W., Morobe Distr., Mt Sarawaket in E.).

*Ecol.* Alpine grasslands, marshy hollows, high mountain ridges, (2100?–)3000–4050 m.

57. *Carex brunnea* THUNB. Fl. Jap. (1784) 38; SCHUHR, Riedgr. 2 (1806) 16, t. Xx f. 111; BOECK. Linnaea 39 (1875) 145; CLARKE, Fl. Br. Ind. 6 (1894) 705; J. Linn. Soc. Bot. 37 (1904) 5; Philip. J. Sc. 2 (1907) Bot. 107; KÜK. Pfl. R. Heft 38 (1909) 599; in Fedde, Rep. 8 (1910) 8, *incl. var. subteinogyna* KÜK.; Philip. J. Sc. 6 (1911) Bot. 63; CAMUS, Fl. Gén. I.-C. 7 (1922) 194; MERR. En. Philip. 1 (1923) 137; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 466; NELMES, Kew Bull. (1950) 201, *incl. var. dolichocarpa* NELMES; Reinwardtia 1 (1951) 357; Kew Bull. 2 (1955) 309; RAYMOND, Mém. Jard. Bot. Montréal n. 53 (1959) 58; KOYAMA, Micronesica 1 (1964) 109, *incl. var. meyenii* (NEES) KOYAMA; KERN in Back. & Bakh. f. Fl. Java 3 (1943) 493. — *C. gracilis* R. BR. Prod. (1810) 242, *non* CURT. 1777; KUNTH, En. 2 (1837) 513; BOOTT, Ill. 1 (1858) 59, t. 154–156; BENTH. Fl. Austr. 7 (1878) 442. — *C. meyenii* NEES, Nova Acta Nat. Cur. 19, Suppl. 1 (1843) 123; KRAUSS, Pac. Sc. 4 (1950) 264–267, f. 8–9. — *C. hattoriana* NAKAI ex TUYAMA, Bot. Mag. Tokyo 49 (1935) 508, t. 15; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 466; AKIYAMA, Car. Far East, Reg. Asia (1955) 103, t. 82, f. 1; KOYAMA, J. Fac. Sc. Un.

Tokyo III, 8 (1962) 164. — *C. kanehirae* OHWI, Act. Phytotax. Geobot. 8 (1939) 67; J. Jap. Bot. 18 (1942) 138. — *C. spadiceo-vaginata* OHWI, Bot. Mag. Tokyo 56 (1942) 215. — *C. teinogyna* (*non* BOOTT) BACK. Bekn. Fl. Java (em. ed.) 1 (1949) fam. 246, p. 61. — *C. buruensis* NELMES, Kew Bull. (1950) 201; Reinwardtia 1 (1951) 360; *ibid.* 2 (1954) 379. — *C. megacarpa* KOYAMA, Bot. Mag. Tokyo 69 (1956) 210, f. 2. — **Fig. 123, 132g.**

Rhizome very short, woody. *Stems* tufted, slender, erect, triquetrous, smooth, or scaberulous on the angles above, (10–)30–100 cm by  $\frac{1}{2}$ – $1\frac{1}{2}$  mm, surrounded below the leaves by dull brown bladeless sheaths tending to split in front into reticulate fibres. *Leaves* subbasal, shorter to longer than the stems, rigid, flattish or conduplicate, rarely subfiliform, usually asperous above, gradually attenuated towards the apex, (1–)2–6 mm wide. *Inflorescence* with (2–)4–8 fascicles of 2–7 spikelets (rarely all the spikelets solitary), narrow, erect or more or less nodding, c. 5–50 cm long, upper fascicles or spikelets approximate and some fastigate, lower rather distant, one of the spikelets at each node (especially at the lower ones) usually longer than the others and with some smaller spikelets branching from it. *Spikelets* erect or suberect, cylindric or narrowly cylindric, rather densely to rather loosely flowered, androgynous (♀ part usually much longer and thicker than the ♂ part, 2–4 mm thick), 1– $4\frac{1}{2}$  cm long, upper sessile or subsessile on included or shortly exserted peduncles, lower on long-exserted, smooth or scaberulous peduncles. Lower bracts foliaceous or subfoliaceous, longer than their fascicles but usually shorter than the inflorescence, long-sheathing, upper bracts much reduced. *Glumes* from much shorter than to almost as long as the utricles, ovate to ovate-lanceolate, acute to obtuse, glabrous, obsoletely nerved but distinctly 3-nerved in the centre, muticous or apiculate, rarely an awn to 2 mm present, light castaneous, sometimes with whitish-hyaline margins, 2–4(–5) mm long. *Utricles* ovoid to oblong-elliptic, plano-convex, membranous, prominently multinerved, shortly whitish setulose at least on the margins, suberect, cinnamonaceous to castaneous, cuneately tapering to a  $\frac{1}{2}$ –1 mm long stipe, subabruptly beaked,  $2\frac{1}{2}$ –5(–6) by 1– $1\frac{1}{2}$  mm; beak  $\frac{1}{2}$ –2 mm, bidenticulate. *Nut* ovate or oblong-ovate, compressed-biconvex, scarcely stipitate and beaked, stramineous,  $1\frac{1}{2}$ – $2\frac{1}{2}$  by 1– $1\frac{1}{4}$  mm. *Style-base* slightly thickened. *Stigmas* 2 (or rarely 3), up to about as long as the utricle.

*Distr.* Widely distributed from Madagascar and the Mascarene Is. to Ceylon, India, Farther India, China, Japan, the Hawaiian Is., New Caledonia, Australia (New South Wales and Queensland); in *Malesia*: New Guinea, Moluccas (Buru), Philippines (Luzon, Bohol, Negros, Mindanao), Celebes, Lesser Sunda Is. (Lombok, Sumbawa, Flores), NW. Borneo (Sarawak), Java (a few localities in

W., Central & E.), N. Sumatra (Pajakumbuh; Gajolands: Ketambe).

Ecol. Primary forest, mossy forest, exposed ridges, grassy slopes, (80–)800–2800(–3100) m, in Lombok in monsoon forest scrub on dry calcareous soil, 200–400 m, in W. Sumatra on limestone hills.

Vern. Philippines: *selak*, Ig., *tayalid*, Bag.

Notes. As will be seen from the above description *C. brunnea* in the sense accepted here is extremely polymorphic, which is to be expected in so wide-ranging a species. Especially Japanese taxonomists have split it up into several micro-species and infraspecific taxa among which I do not see sharp distinctions. To me it is even very doubtful whether 59. *C. teinogyna* and 56. *C. bilateralis*, both closely related to *C. brunnea*, but which I have decided to treat provisionally as separate species, can be upheld as such in future.

Typical *C. brunnea*, described from Japan, has small, broadly ovate, c.  $2\frac{1}{2}$  mm long utricles subtended by distinctly shorter glumes. Malesian specimens approaching this have only been found in N. Luzon.

According to KOYAMA (1962) the greater part of the Malesian specimens belong to *C. hattoriana* NAKAI ex TUYAMA, occurring from Bonin and Formosa through Malesia to Australia. To him it is quite distinct from *C. brunnea* by the strikingly large utricles  $4\text{--}4\frac{1}{2}$  mm long, the longer glumes, and the larger ♂ part of the spikelets.

*Carex spadiceo-vaginata* OHWI, from New Guinea, is said to differ from *C. brunnea* by its looser spikelets, sparsely setulose, 3 mm long utricles with longer beak.

The type of *C. buruensis* NELMES is a very delicate plant with almost filiform leaves and reduced inflorescences, which may be due to the habitat. Essential differences with *C. brunnea* I cannot find. It is connected with broader-leaved specimens of *C. brunnea* by a collection from New Guinea, which to NELMES "represents a new variety or perhaps a new species".

I share the opinion of KOYAMA that *C. meyenii* NEES (*C. brunnea* ssp. *meyanii* (NEES) KOYAMA) differing from typical *C. brunnea* by the lanceolate,  $3\text{--}4\frac{1}{2}$  mm long, long-beaked utricles setulose only on the margins, falls within the variability of *C. brunnea*, but refrain from maintaining it as a subspecies. I also agree with KOYAMA in the reduction of *C. kanehirae* OHWI from Micronesia, to *C. brunnea*. I expect that several other 'species' described from Japan and the Pacific will have to be reduced to the polymorphic *C. brunnea*.

*Carex brunnea* var. *subteinogyna* KÜK. (non *C. subteinogyna* OHWI), from the Philippines was described as having looser spikelets, lighter coloured, longer, acuminate glumes 5 mm long, and very long-beaked and sparsely setulose utricles with longer stipe. NELMES (1950) altered this

circumscription considerably so as to cover also specimens from Celebes and New Guinea, and described moreover a var. *dolichocarpa* NELMES with  $5\text{--}5\frac{3}{4}$  mm long utricles from Java. The latter variety is undoubtedly the same as *C. megacarpa* KOYAMA. I fail to see how to draw a line between the two varieties.

The collection DE WILDE 14068 from the Gajolands often has 3 styles and accordingly trigonous (fertile) nuts, and the terminal spikelets are wholly ♂. This might be a hybrid with 20. *C. verticillata*. — (NOOT.)

58. *Carex longipes* D. DON, Trans. Linn. Soc. 14 (1825) 329; DREJER, Symb. Caric. (1844) 24, t. 10; MIQ. Fl. Ind. Bat. 3 (1856) 347; BOOTH, Ill. 4 (1867) 190; BOECK. Linnaea 40 (1876) 376; CLARKE, Fl. Br. Ind. 6 (1894) 704; J. Linn. Soc. Bot. 34 (1898) 108; *ibid.* 36 (1903) 295; KÜK. Pfl. R. Heft 38 (1909) 603; Bot. Jahrb. 70 (1940) 467, incl. var. *ramosa* KÜK.; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 61; NELMES, Reinwardtia 1 (1951) 361; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 58; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 493; STEEN. Mt. Fl. Java (1972) pl. 14–6. — Fig. 123, 134.

Rhizome very short. Stems tufted, slender, erect, trigonous, smooth except on the angles above, 15–80 cm by  $1\text{--}1\frac{1}{2}$  mm, surrounded below the leaves by the fibrous, brownish remains of old leaf-sheaths. Leaves subbasal, rarely one higher up the stem, shorter to somewhat longer than the stem, flat, scabrid,  $1\frac{1}{2}\text{--}6$  mm wide. Inflorescence very lax, with up to 7 spikelets, 10–40 cm long. Spikelets single at the nodes, erect or the lower cernuous, cylindric, simple or the lower 1–3 branched near the base, lax-flowered, androgynous (♀ part much longer than the very short ♂ part), rarely wholly ♀,  $1\text{--}3\frac{1}{2}\text{--}(4\frac{1}{2})$  cm by 4–6 mm, upper approximate, sessile, or subsessile on shortly exerted peduncles, lower distant on filiform, minutely scabrid, usually long-exserted peduncles, the lowest often near the base of the stem. Lower bracts foliaceous, shorter than inflorescence, long-sheathing, upper much reduced. Glumes 3–4 mm, shorter than the utricles, ovate-lanceolate to lanceolate, acute or subtruncate to bilobed-emarginate, pale ferrugineous with whitish hyaline margins, glabrous, with darker 3-nerved central stripe, the midnerve excurrent in a stoutish, straight, antrorsely scabrid, up to 5 mm long awn often overtopping the utricle. Utricles elliptic, compressed, biconvex, membranous, dorsally strongly 6–9-nerved, less distinctly nerved ventrally, glabrous and smooth or rarely the margins setulose, straight, obliquely erect, scarcely stipitate, pale green, fully ripe yellowish to light brown, shining, subabruptly long-beaked,  $5\text{--}7$  by  $1\frac{1}{2}\text{--}2$  mm; beak sparsely hispid above, 2–3 mm long, deeply bidentate (teeth  $\frac{1}{2}\text{--}\frac{3}{4}$  mm). Nut broadly elliptic to ovate, biconvex, stipitate, abruptly beaked,  $2\frac{1}{2}\text{--}3$  by  $1\frac{1}{2}\text{--}$





Fig. 134. *Carex longipes* D. DON. a. Habit,  $\times \frac{1}{2}$ , b. young fruit with utricle in axil of bract, c. fruit in utricle, d-e. fruits, all  $\times 7$  (VAN STEENIS 6788).

$1\frac{3}{4}$  mm. *Style* distinctly thickened at the base, subsistent. *Stigmas* 2, shorter than the utricle.

*Distr.* Nepal and India to China (Hupeh) and Indo-China (Tonkin); in *Malesia* very rare: Java (a few localities in W., Central and E.), Celebes (Menado, Poso, top of G. Lumut), and NE. New Guinea (Sattelberg).

*Ecol.* In forests, along forest-trails, on swampy mountain meadows, 1500–2200 m.

**59. *Carex teinogyna* BOOTT, Ill. 1 (1858) 60, t. 158; BOECK, *Linnaea* 39 (1875) 145; CLARKE, *Fl. Br. Ind.* 6 (1894) 705; KÜK. Pfl. R. Heft 38 (1909) 602, f. 102 F–H ('*teinogyna*'), incl. var. *scabriculum* KÜK.; Bull. Jard. Bot. Btzg III, 16 (1940) 320, excl. pl. jav.; NELMES, *Reinwardtia* 2 (1954) 378; Mém. Mus. Hist. Nat. Paris n.s. B4 (1955) 146; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 59; KOYAMA, Bot. Mag. Tokyo 72 (1959) 307; J. Fac. Sc. Un. Tokyo III, 8 (1962) 162. — *C. scabriculum* OHWI, Act. Phytotax. Geobot. 2 (1933) 27; Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 468; AKIYAMA, Car. Far East. Reg. Asia (1955) 102, t. 80; YOSHIKAWA, Ic. Jap. *Carex* 2 (1958) 246, t. 123. — *C. brunnea* (non THUNB.) NELMES, Kew Bull. (1950) 200. — Fig. 123.**

*Rhizome* very short, woody. *Stems* tufted, slender, erect, triquetrous, smooth or scabrid on the angles above, 20–60 cm by  $\frac{1}{2}$ –1 mm, surrounded below the leaves by spadiceous sheaths ultimately fraying into persistent fibres. *Leaves* subbasal, shorter to slightly longer than the stems, flat to conduplicate, stiff, long-attenuate, asperous especially in the upper part, 2–3(–4) mm wide. *Inflorescence* with 3–6 fascicles of 1–3 spikelets, narrow, 10–20 cm long, upper fascicles approximate, lower more distant. *Spikelets* erect, mostly simple, rarely branched at the base, lax-flowered, androgynous ( $\varnothing$  part longer than the  $\sigma$  one), upper on scarcely, lower on shortly to rather long-exserted, smooth or scabrid peduncles, up to 3 cm long. Lower bracts foliaceous, longer than their fascicles but usually shorter than the inflorescence, long-sheathing, upper much reduced. *Glumes* about as long as utricles, oblong-lanceolate, acuminate, acute, translucent, glabrous, ferrugineous, sometimes with pale-hyaline margins above, mucicous or with an awn up to 2 mm long,  $3\frac{1}{2}$ –5 mm long. *Utricles* elliptic, plano-convex or compressed-biconvex, membranous, slenderly multinerved, suberect, castaneous, whitish appressed-hispidulous, cuneate-stipitate, subabruptly beaked,  $3\frac{1}{2}$ – $4\frac{1}{2}$  (–5) by  $1\frac{1}{3}$  mm; stipe  $\frac{1}{3}$ – $\frac{1}{2}$  mm; beak  $1\frac{1}{2}$ –2 mm, bidentate. *Nut* elliptic to oblong-elliptic, compressed-biconvex, not stipitate, shortly beaked, brown,  $2$ (– $2\frac{1}{2}$ ) by  $1$ (– $1\frac{1}{4}$ ) mm. *Style-base* slightly thickened. *Stigmas* 2, very long (7–12 mm), flexuous, persistent.

*Distr.* Assam, Upper Burma, S. China (Hunan), Tonkin, Annam, Japan (Honshu, Shikoku,

Kyushu), Korea (Quelpaert); in *Malesia*: N. Sumatra (Atjeh: Leuser; Gajolands: Mt Kemiri and Sangir Valley).

Ecol. Rocky riverbanks, ravines, 200–1150 m. Note. Sometimes the glumes of the ♂ flowers cup-shaped, the margins connate in front.

## 26. Section *Paludosae*

[FRIES, Fl. Scan. (1835) 190, *pro grege*; TUCKERM. En. Meth. (1843) 14; O. F. LANG, Linnaea 24 (1851) 618]; BAILEY, Proc. Am. Ac. 22 (1886) 74, as group; KÜK. Pfl. R. Heft 38 (1909) 730. — *Subsect. Lacustres* CAREY in Gray, Man. (1848) 561. — *Sect. Tumidae* MEINSH. Act. Hort. Petrop. 18 (1901) 283, 376.

Type species: *Carex paludosa* GOODEN.

Insufficiently known

### 60. *Carex* sp.

Rhizome woody, emitting stout stolons covered with pale sheaths. *Stem* rather stout, triquetrous, smooth, leafy, c. 60 cm by 3 mm. *Leaves* basal, overtopping the stem, long-attenuate, flat or somewhat folded lengthwise, septate-nodulose, glaucous-green, subcoriaceous, c. 5 mm wide; ligule lanceolate, acute, c. 1½ cm long; margins smooth below, scabrid above; lower sheaths strongly septate-nodulose, not fibrous, stramineous or light brown. *Inflorescence* erect, consisting of 4 spikelets. Terminal *spikelet* ♂, c. 1½ cm long, 2 mm wide, lateral spikelets ♀, erect, cylindrical, densely flowered, the upper 2 approximate, subsessile, the lowest distant on a smooth, 1½ cm long peduncle. Bracts foliaceous overtopping the inflorescence, not or scarcely sheathing. *Glumes* of the ♀ flowers ovate, deeply emarginate at the top, pale with purplish margins, c. 3 mm long, the

strong midrib excurrent in a firm, smooth or scabrid awn about as long as the glume; glumes of the ♂ flowers similar, more oblong, purplish with pale centre. *Utricles* young, lanceolate, glabrous, many-nerved, 5–5½ by 1½ mm, rather gradually narrowed into the stout, straight, bidentate beak with straight, ⅓ mm long teeth. *Style* straight, ciliolate, c. 2 mm, not thickened at the base. Stigmas 3, longer than the style.

Distr. *Malesia*: New Guinea: Western Highlands, Sirunki, swamp near Nanguris village, in fast flowing very deep water course (water depth approx. 230 cm), at c. 2500 m, 14 Sept. 1962: WALKER ANU 691 (CANB).

Note. Only a single, immature specimen was collected. The plant is related to the Eurasian *C. riparia* CURT., from which it differs by the narrower leaves, the small, single ♂ spikelets, and the deeply incised ♂ and ♀ glumes, and to the Japanese *C. rugulosa* KÜK. (not seen).

## II. Subgenus *Vignea*

(BEAUV.) CLARKE, Fl. Br. Ind. 6 (1894) 700; KÜK. Bot. Jahrb. 27 (1899) 495; Pfl. R. Heft 38 (1909) 111; NELMES, Reinwardtia 1 (1951) 431. — *Vignea* BEAUV. in Lestib. Ess. Fam. Cyp. (1819) 22.

Type species: *Carex arenaria* L.

## 27. Section *Divisae*

[CHRIST, Bull. Soc. Bot. Belg. 24 (1885) 18, *nomen*]; (KÜK.) KÜK. Pfl. R. Heft 38 (1909) 119; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 234. — *Sect. Capituligeræ* KÜK. *subsect. Divisæ* CHRIST ex KÜK. Bot. Jahrb. 27 (1899) 500.

Type species: *Carex divisa* HUDS.

61. *Carex duriuscula* C. A. MEY. Mém. Ac. St. Pétersb. 1 (1831) 214, t. 8; KUNTH, En. 2 (1837) 373; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 234. — *C. stenophylla* WAHLENB. var. *duriuscula* TRAUTV. Act. Hort. Petrop. 10 (1887–

89) 537; KÜK. Pfl. R. Heft 38 (1909) 121. — *Carex* sp. NELMES, Kew Bull. (1949) 386; Reinwardtia 1 (1951) 446.

Rhizome creeping, slender, c. 1 mm thick, clothed with brown sheathing scales. *Stems* erect



or curved, trigonous, smooth, or scaberulous below the inflorescence, 7–15 cm by  $c. \frac{1}{2}$  mm. *Leaves* subbasal, shorter than the stems, rigid, curved, circinnate at the apex, canaliculate to convolute, smooth or scaberulous towards the apex,  $c. 1$  mm wide. *Spikelets* 4–7, androgynous ( $\sigma$  part about as long as the  $\rho$ ), sessile, approximate, elliptic-lanceolate (very young), subdense-flowered, 5–7 mm long, forming a more or less oblong head 1–1½ by  $c. \frac{1}{2}$  cm. Bracts glumiform, the lower long-awned. *Glumes* oblong-lanceolate or ovate-lanceolate, acutish, very thin, translucent, castaneous with broad whitish-hyaline margins, 3½–4 mm long, the midrib not extending to the apex to very shortly excurrent. *Utricles* (very immature) elliptic, plano-convex, nerveless, glabrous, scabrid on the margins in the upper half, 3–4 by  $c. 1$  mm, tapering above into a short beak

with oblique mouth. Stigmas 2, about as long as the utricule.

Distr. Siberia, N. Mongolia and Manchuria; in *Malesia*: New Guinea, Lake Habbema (BRASS 9235) in W., Mt Victoria (LAE 61670) and Kondo, Mt Hagen (NGF 43535) in E.

Ecol. In New Guinea in sunny bog and alpine grassland, 2400–3225 m.

Note. NELMES, *l.c.*, supposed this New Guinea collection to be close to *C. arenicola* F. SCHMIDT, but I agree with S. T. BLAKE, *J. Arn. Arb.* 28 (1947) 116, that it is evidently allied to *C. stenophylla* WAHLB. of the northern hemisphere. The resemblance to small, narrow-leaved specimens of the latter is surprising. I have seen extra-Malesian material of *C. duriuscula*; the BRASS collection very well matches the collection I saw of this species, which is apparently very near to *C. stenophylla*.

## 28. Section *Paniculatae*

[KUNTH, En. 2 (1837) 389, *nomen*]; MEINSH. Act. Hort. Petrop. 18 (1901) 281, 313; KÜK. Pfl. R. Heft 38 (1909) 174; NELMES, Reinwardtia 1 (1951) 432. — *Sect. Muricatae* FRIES *subsect. Paniculatae* KUNTH *ex* KÜK. Bot. Jahrb. 27 (1899) 515.

Type species: *Carex paniculata* L.

62. *Carex appressa* R. BR. Prod. (1810) 242; KUNTH, En. 2 (1837) 389; KUNZE, Suppl. Riedgr. (1840–50) 45, t. 11; BOOTT, Ill. 1 (1858) 46, t. 119, 120; BOECK. Linnaea 39 (1875) 99; KÜK. Pfl. R. Heft 38 (1909) 178, f. 29 E–J; Bot. Jahrb. 69 (1938) 261; OHWI, Bot. Mag. Tokyo 56 (1942) 214; S. T. BLAKE, *J. Arn. Arb.* 28 (1947) 101; NELMES, Kew Bull. (1949) 386, 392; Reinwardtia 1 (1951) 432; Kew Bull. 2 (1955) 318. — *C. paniculata* (non L.) BENTH. Fl. Austr. 7 (1878) 440. — Fig. 123.

Rhizome short, stout, woody, forming very dense clumps. *Stems* densely tufted, erect, triquetrous (often very acutely so), rigid, scabrid on the angles above (see note), 30–180 cm by 2–4 mm, surrounded below the leaves by spadiceous, dark-nerved, bladeless sheaths and their fibrous remains. *Leaves* in the lower ¼–⅓ of the stem, shorter to longer than the stem, very stiff, flat to conduplicate, long-acuminate, with very scabrous margins, pale green, 3–10 mm wide. *Inflorescence* a slender, oblong-cylindric, contracted, spike-like panicle, 5–25 by 1–2 cm; branches numerous, erect, often appressed or even partly adnate to the stems, upper crowded, lower approximate or slightly distant. Bracts inconspicuous, setaceous, lower sometimes as long as the branches, upper reduced to glumes. *Spikelets* very numerous, sessile, androgynous, ovoid or ovoid-lanceolate, few-flowered ( $\sigma$  and  $\rho$  parts about equal in length), 4–8 mm long. *Glumes* ovate, acute, thin and

translucent, with ciliolate margins, otherwise glabrous, slenderly nerved, ferruginous to castaneous with hyaline margins, 2–3 mm long, the midrib often excurrent in a short mucro up to ½ mm long. *Utricles* ovate, plano-convex, with obtuse margins, coriaceous, 6–12-nerved dorsally, 3–6-nerved ventrally, glabrous, distinctly setulose-margined above, subpatent, stramineous to dark brown, rounded at the spongy-thickened base, shortly stipitate, subabruptly beaked, 2½–3½ by 1¼–2 mm; beak ½–1 mm long, bidentate, grooved on the back, with slightly oblique mouth. *Nut* ovate to obovate, compressed-biconvex, broadly stipitate, beakless or shortly beaked, 1¼–1¾ by  $c. 1$  mm. Stigmas 2.

Distr. Widespread in Australia, also in New Zealand and New Caledonia; in *Malesia*: New Guinea (Arfak Mts, Lake Habbema in W. and Western Highlands, Finisterre Range, Mt Sarawaket, in E.).

Ecol. Open marshes, shores of lakes, alpine meadows, 1900–3225 m, on Mt Sarawaket as low as 900 m.

Vern. *Kwajare*, Enga.

Note. The stems are sometimes smooth or almost so:

*var. virgata* (SOL. *ex* BOOTT) KÜK. Pfl. R. Heft 38 (1909) 179 (*C. virgata* SOL. *ex* BOOTT in Hook. f. Fl. Nov. Zel. 1 (1853) 282; Ill. 1 (1858) 46, t. 121, 122; BOECK. Linnaea 39 (1875) 98.) — Only known from New Zealand and Tasmania.

## 29. Section Multiflorae

[KUNTH, En. 2 (1837) 387, *nomen*]; (CAREY) BAILEY, Proc. Am. Ac. 22 (1886) 135, as group; KÜK. Pfl. R. Heft 38 (1909) 142; NELMES, Reinwardtia 1 (1951) 433; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 19. — *Sect. Vigneae* BEAUV. *subsect. Multiflorae* CAREY in Gray, Man. Bot. N. Un. St. (1848) 540. — *Sect. Muricatae* FRIES *subsect. Multiflorae* KÜK. Bot. Jahrb. 27 (1899) 514.

Type species: *Carex multiflora* MUEHL. ex WILLD.

63. *Carex nubigena* D. DON, Trans. Linn. Soc. 14 (1825) 326; NEES in Wight, Contr. (1834) 120; KUNTH, En. 2 (1837) 385; BOOTT, Ill. 1 (1858) 1, t. 2; BOECK. Linnaea 39 (1875) 90; CLARKE, Fl. Br. Ind. 6 (1894) 702; J. Linn. Soc. Bot. 37 (1904) 5, *incl. var. fallax* CLARKE; KÜK. Pfl. R. Heft 38 (1909) 145, *incl. var. fallax* KÜK.; in Hochr.

Candollea 6 (1936) 430; BACK. Bkn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 60; NELMES, Reinwardtia 1 (1951) 434, *excl. specim. Sumatrae*; KOYAMA, Bot. Mag. Tokyo 72 (1959) 302; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 494; STEEN. Mt Fl. Java (1972) pl. 14-1. — *C. fallax* STEUD. [in Zoll. Syst. Verz. (1854) 60]; Syn. 2 (1855) 189;



Fig. 135. *Carex nubigena* D. DON in tufts around a shallow depression (sawahan), probably the site of an old silted-up crater, covered with a heavily deer-grazed, very short turf of herbs and grasses subject to frost in the dry season; background some scattered *Casuarina junghuhniana* MIQ. Mixed with tussocks of *Pennisetum alopecuroides* (L.) SPR. East Java, Mt Jang, c. 2000 m altitude (VAN STEENIS, 1936).



Miq. Fl. Ind. Bat. 3 (1856) 347; BOECK. Linnaea 39 (1875) 57; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 247 (var. *franchetiana* OHWI). — Fig. 123, 135.

Rhizome short, woody, forming dense tufts. *Stems* erect, slender but rigid, smooth or slightly scaberulous just below the inflorescence, obtusely trigonous, 20–60(–100) cm by 1–3 mm, clothed below the leaves by brownish to pale, bladeless sheaths and their fibrous remains. *Leaves* subbasal, shorter to longer than the stems, rigid, canalliculate to conduplicate, with scabrid margins,  $1\frac{1}{2}$ –3 mm wide. *Inflorescence* pyramidal to oblong, head-like or spike-like, 1–3(–5) cm by 7–13 mm. *Spikelets* 5–10(–15), crowded, or lowest 1–2 sometimes slightly separated, ovoid to subglobose, sessile, androgynous (with very few ♂ flowers), 5–10 by 5–7 mm. Lower 2–3 bracts foliaceous, membranous-margined at the base, erect or curved, lowest much exceeding, other equalling to exceeding the inflorescence, upper much reduced to glume-like, none sheathing. *Glumes* ovate to oblong-lanceolate, acutish, very thin, translucent, ferrugineous to whitish hyaline, with brownish to greenish, 3-nerved central stripe,  $2\frac{1}{4}$ – $3\frac{1}{2}$  mm long, with a mucro up to 1 mm long. *Utricles* ovate or

ovate-lanceolate, plano-convex, membranous, strongly many-nerved on both faces, winged, glabrous, obliquely erect, greenish to brown, spongy-thickened at the base, shortly stipitate, subgradually beaked,  $3\frac{1}{2}$ – $4\frac{1}{2}$  by  $1\frac{1}{3}$ –2 mm; beak c.  $1\frac{1}{2}$  mm, serrulate-margined, dorsally grooved, bidentate. *Nut* elliptic to suborbicular, biconvex, broadly stipitate, shortly beaked,  $1\frac{1}{4}$ – $1\frac{3}{4}$  by  $\frac{4}{5}$ –1 mm. *Style-base* not or scarcely thickened. Stigmas 2 (according to BOOTT occasionally 3).

Distr. From Ceylon, S. India and the Himalaya to China (Hupeh, Yunnan), Formosa and Japan; in *Malesia*: Java (Central: Diëng Plateau; East: Mts Kawi, Tengger-Semeru & Jang). Distr. map in Bot. Mag. Tokyo 72 (1959) 302, f. 23 (the area in *Malesia* should be restricted to Central and East Java!).

Ecol. Marshy places, along streams, according to BACKER 1600–3000 m, sometimes gregarious. On Mt Jang deer feed on this species of which the leaf-bases have a sweet taste, as in *Gahnia javanica* (VAN STEENIS, l.c.).

Note. The immature collection LAE 65208 from New Guinea (W. slope of Mt Kenive,  $9^{\circ} 10' S$  and  $147^{\circ} 45' E$ ) might possibly be referred to this species. — (NOOT.)

### 30. Section *Stellulatae*

KUNTH, En. 2 (1837) 399; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 253; NELMES, Reinwardtia 1 (1951) 441. — *Sect. Elongatae* KUNTH *sensu* KÜK. Pfl. R. Heft 38 (1909) 226, p.p.

Type species: *Carex stellulata* GOODEN.

64. *Carex echinata* MURR. Prod. Stirp. Gotting. (1770) 76; BOECK. Linnaea 39 (1875) 124; BENTH. Fl. Austr. 7 (1878) 439. — *C. stellulata* GOODEN. Trans. Linn. Soc. 2 (1794) 144; KÜK. Pfl. R. Heft 38 (1909) 228. — *C. nubigena* (non DON) KÜK. Bull. Jard. Bot. Btzig III, 16 (1940) 314. — *C. perileia* S. T. BLAKE, J. Arn. Arb. 28 (1947) 102; NELMES, Kew Bull. (1949) 386, 392; Reinwardtia 1 (1951) 441. — *C. gajonum* NELMES, Kew Bull. (1952) 84; Reinwardtia 2 (1954) 382. — *C. omiana* FRANCH. & SAV. var. *perileia* KOYAMA, Bot. Mag. Tokyo 69 (1956) 211. — Fig. 123, 131h.

Rhizome short, forming dense tufts. *Stems* slender, erect, obtusely trigonous below, more acutely so above, smooth or slightly scaberulous just below the inflorescence, 15–90 cm by 1–2 mm. *Leaves* subbasal, shorter to longer than the stems, canalliculate-conduplicate, long-attenuate, scabrid on the margins above, 1–3 mm wide, the lower ones reduced to pale to castaneous, bladeless sheaths. *Inflorescence* ovoid to oblong, head-like or spike-like,  $1\frac{1}{2}$ – $3\frac{1}{2}$ (– $4\frac{1}{2}$ ) cm long. *Spikelets* 3–8, gynaeandrous (♂ flowers very few), ellipsoid, obovoid or ovoid to subglobose, sessile, dense-

flowered, approximate or lowest somewhat distant, 5–10 by 5–8 mm, finally squarrose by the widely spreading utricles. Bracts glumiform, the lowest with a setaceous awn, others more shortly aristate, or indistinguishable from the glumes or the lower bracts foliaceous, overtopping the inflorescence. *Glumes* ovate, acute, thin, wholly pale or brownish with wide whitish-hyaline margins, 3-nerved in the centre,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm long. *Utricles* elliptic or ovate-lanceolate to broadly ovate, rounded to cordate at the base, plano-convex, membranous, several-nerved on both faces, glabrous, smooth, straight or slightly recurved, widely patent to reflexed when mature, spongy-thickened at the base, scarcely stipitate, (3–)4–5(– $5\frac{1}{2}$ ) by (1–)1½–2 mm, yellowish green to brownish, subgradually narrowed into a bidenticulate beak more or less scabrid on the margins or rarely wholly smooth and with a dorsal split with brown overlapping margins. *Nut* oblong-ovoid, plano-convex, scarcely stipitate and beaked, brownish, 2– $2\frac{1}{2}$  by 1– $1\frac{1}{2}$  mm. *Style-base* slightly thickened. Stigmas 2.

Distr. N. America, Eurasia to Australia and New Zealand; in *Malesia*: N. Sumatra (Gajolands:

Mts Kemiri, Losir, Bandahara) and New Guinea (Arfak and Lake Habbema in W., and many mountains in E.).

Ecol. Peat swamps, wet alpine grasslands, marshy lake shores, 1850–3600 m, locally often abundant.

Vern. New Guinea: *kisis*, *pemp*, Papua, Mendi lang., *koali*, Enga lang., *armemsèna*, *kul*, Manikiong lang.

Notes. In the wide sense here accepted *C. echinata* is a widely spread species. The characters used for differentiating the numerous microspecies described in sect. *Stellulatae* are far from reliable; they mainly refer to the width of the leaves, the size of the utricles, the scabridity of their margins and the intensity of their nervation. For N. America MACKENZIE, N. Am. Fl. 18 (1931) 99–114 recognized *c.* 20 spp. which can hardly be maintained. I have not seen Japanese materials of the section, but to judge from the descriptions and figures *C. basilata* OHWI, Act. Phytotax. Geobot. 11 (1942) 258; YOSHIKAWA, Ic. Jap. Carex 3 (1960) 296, t. 148 [*C. muricata* (non L.) OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 253; AKIYAMA, Car. Far East. Reg. Asia (1955) 64, t. 31] is hardly different from the European plants, and *C. omiana* FRANCH. & SAV.; OHWI, l.c. 254; AKIYAMA, l.c. t. 32 with its lanceolate utricles less scabrid margins must be very near to the New Guinean specimens.

*Carex perileia* S. T. BLAKE was based on a specimen with a single fruiting culm, and distinguished from *C. echinata* by its narrower leaves and its longer utricles with relatively larger beak deeply

split on the back with entirely smooth margins. Several additional collections have shown that size and scabridity of the utricles are very variable. Sometimes the utricles are not longer and hardly less scabrid than in European materials. In typical *C. echinata* the uppermost spikelet is seemingly long-stalked by the relatively large number of ♂ flowers at its base and sometimes almost wholly ♂, in the New Guinean specimens also this spikelet is sessile as there are so few ♂ flowers that it has a wholly ♀ appearance. This may be the same in some Australian forms of *C. echinata*, as according to BENTHAM, l.c., there are very few ♂ flowers at the base of the spikelets, sometimes even none.

Whether *C. perileia* represents a special New Guinea race cannot be decided without a critical study of the whole section or of at least the Australasian and E. Asian representatives; in my opinion it is not specifically distinct.

*Carex gajonum* NELMES, from N. Sumatra (Gajolands: Mts Losir and Kemiri), was distinguished because the lower bracts are foliaceous, much overtopping the inflorescence, and the utricles being broader, cordate at the base, and obliquely erect instead of widely patent when mature. In some Sumatran plants, however, the lower bracts are setaceous, in some New Guinean ones they are foliaceous, overtopping the inflorescence. In the collection DE WILDE 13323, from Mt Bandahara, the ripe utricles are patent as in true *C. echinata*, making the spikelets squarrose. Furthermore I compared several utricles, and although they are generally broader in Sumatra, there is no constant difference. — (Noot.)

### 31. Section *Elongatae*

KUNTH, En. 2 (1837) 402; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 256; KÜK. Pfl. R. Heft 38 (1909) 226, p.p.; NELMES, Reinwardtia 1 (1951) 438.

Type species: *Carex elongata* L.

65. *Carex remota* LINNÉ, Amoen. 4 (1759) 293; BOECK. Linnaea 39 (1875) 129; KÜK. Pfl. R. Heft 38 (1909) 233.

The typical subspecies is widely distributed in Europe, extending to N. Africa and W. Asia; in *Malesia* two other subspecies occur:

a. *spp. alta* (BOOTT) KÜK. Pfl. R. Heft 38 (1909) 234, incl. var. *brizopyrum* KÜK.; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 60; KERN in BACK. & BAKH. f. Fl. Java 3 (1968) 494; STEEN. Mt. Fl. Java (1972) pl. 14–4. — *C. alta* BOOTT, Proc. Linn. Soc. 1 (1845) 254; Trans. Linn. Soc. 20 (1846) 130; Ill. 1 (1858) 59, t. 153; MIQ. Fl. Ind. Bat. 3 (1855) 347; BOECK. Linnaea 39 (1875) 126; CLARKE, Fl. Br. Ind. 6 (1894) 707; J. Linn. Soc. 37 (1904) 6; NELMES, Reinwardtia 1 (1951) 438. —

*C. brizopyrum* KUNZE, Suppl. Riedgr. (1840–50) 169, t. 43. — *C. remota* var. *rochebrunii* CLARKE, J. Linn. Soc. 37 (1904) 6, p.p. (*quoad* ZOLLINGER 3192). — *C. craspedotricha* NELMES, Kew Bull. (1939) 657; *ibid.* (1946) 28; RAYM. Mém. Jard. Bot. Montréal n. 53 (1959) 19; Dansk Bot. Ark. 23 (1965) 252. — ? *C. imbricata* KÜK. in Hand.-Mazz. Symb. Sin. 7 (1936) 1260, f. 38 n. 2. — ? *C. squamata* KREZC. Not. Syst. Herb. Inst. Bot. Ac. Sc. URSS 9 (1946) 196. — Fig. 123.

Rhizome very short, woody. Stems densely tufted, stiff to rather weak, erect or suberect, smooth, 15–80(–120) cm by 1–1½ mm, surrounded at the base by brown, fibrous remains of old leaf-sheaths. Leaves in the lower 1/3 of the stem, shorter to longer than the stems, flat, scabrid on the margins especially towards the long-attenuated



apex,  $1\frac{1}{2}$ –4 mm wide; sheaths long, mouth concave in front. *Spikelets* 5–18(–24) in an up to c. 15 cm long, spiciform inflorescence, sessile, obliquely erect, upper densely crowded, lower separated to their own length from one another, lowest 1–2 often distant, ellipsoid to ellipsoid-cylindric, densely flowered, gynaeandrous with only a few ♂ flowers, 5–15 by 3–5 mm. Lower bracts foliaceous, far exceeding the inflorescence, not sheathing, upper glumiform. *Glumes* ovate or oblong-ovate, acute, thin and translucent, finely nerved, whitish with greenish 3-nerved centre, 2–3 mm long, usually excurrent in a short, up to  $\frac{1}{2}$  mm long mucro. *Utricles* ellipsoid or ovoid-ellipsoid (often in outline broadest above the middle because of the wings), obliquely erect, plano-convex, membranous, slenderly nerved on both sides in the lower centre, glabrous, winged in the upper  $\frac{1}{2}$ – $\frac{3}{4}$ , yellowish green to brownish, scarcely stipitate, subabruptly beaked,  $2\frac{3}{4}$ –3 by  $1\frac{1}{4}$  mm; wings varying in width, denticulate-ciliate; beak c.  $\frac{1}{2}$  mm long, bidentate with slender, straight teeth. *Nut* ellipsoid or ovoid, biconvex, shortly stipitate and beaked,  $1\frac{1}{3}$ – $1\frac{2}{3}$  by  $\frac{2}{3}$ – $\frac{5}{6}$  mm. *Style* slightly thickened at the base. *Stigmas* 2.

*Distr.* Insufficiently known; according to literature from India (Himalaya) to Central China; *C. craspedotricha* NELMES from Thailand undoubtedly belongs here. The type collection of both *C. alta* BOOTT and *C. brizopyrum* KUNZE are from Java; in Malesia only known from Java (from Mt Patuha in W. to Jang in E.).

*Ecol.* In moist or swampy grasslands, along water-courses, damp forest-borders, 1500–2200 m; once collected at 1150 m.

*b. ssp. rochebrunii* (FRANCH. & SAV.) KÜK. Pfl. R. Heft 38 (1909) 234; KERN in Back. & Bakh. f. Fl. Java 3 (1968) 494. — *C. rochebrunii* FRANCH. & SAV. En. Pl. Jap. 2 (1879) 126, 555; NELMES, Kew Bull. (1946) 29. — *C. remota* var. *rochebrunii* CLARKE, Fl. Br. Ind. 6 (1894) 707. — *C. monopleura* KRECH. Not. Syst. Herb. Inst. Bot. Ac. Sc. URSS 7 (1937) 35; NELMES, Kew Bull. (1950) 208; Reinwardtia 1 (1951) 440.

Usually slenderer than *ssp. alta*, with narrower leaves. Inflorescence up to 10 cm long, with 3–9 spikelets; upper spikelets not rarely sterile. *Glumes*  $\frac{3}{4}$ –4 mm long. *Utricles* lanceolate, ventrally nerveless or nearly so, narrowly winged,  $4\frac{1}{2}$  mm long. *Nut* elliptic-oblong, c. 2 by 1 mm.

*Distr.* India (Sikkim), China, Japan, Formosa; in Malesia: Sumatra (Atjeh: G. Leuser, and W.: Mt Kerintji) and W. Java (Mt Papandajan).

*Ecol.* Marshy places in forests, along rivers and streamlets, 1700–2700 m.

*Notes.* *Ssp. rochebrunii* is very near to the European *ssp. remota*, mainly differing by the narrow, lanceolate, narrowly winged utricles and the oblong nuts. In my opinion the differences between *C. rochebrunii* (described from Japan) and *C. monopleura* (based on Sikkim material) are too slight to justify specific separation.

In its extreme tall form, with relatively dense inflorescence and broadly winged utricles, *ssp. alta* gives the impression of being a separate species, but slender, weak plants occur (they were distinguished as var. *brizopyrum* by KÜKENTHAL), and the width of the wings of the utricles is variable.

KUNZE, l.c., in describing *C. brizopyrum*, stressed the importance of the bristly appendage of the connective, but this is also found in European *C. remota*.

### 32. Section Heleonastes

KUNTH, En. 2 (1837) 393; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 261; NELMES, Reinwardtia 1 (1951) 443.

Type species: *Carex heleonastes* EHRH.

66. *Carex curta* GOODEN. Trans. Linn. Soc. 2 (1794) 145; SCHKUHR, Riedgr. 1 (1801) 43, t. C, f. 13; KUNTH, En. 2 (1837) 403; S. T. BLAKE, J. Arn. Arb. 28 (1947) 101; NELMES, Kew Bull. (1949) 386; Reinwardtia 1 (1951) 443; YOSHIKAWA, Ic. Jap. Carex 1 (1957) 32, t. 16. — *C. canescens* (non L.) BOOTT, Ill. 4 (1867) 154, t. 496; BOECK. Linnaea 39 (1875) 122, excl. var.  $\beta$ ; BENTH. Fl. Austr. 7 (1878) 439; CLARKE, Fl. Br. Ind. 6 (1894) 706; KÜK. Pfl. R. Heft 38 (1909) 216, f. 35 C–E; OHWI, Mem. Coll. Sc. Kyoto Imp. Un. B11 (1936) 268; AKIYAMA, Car. Far East. Reg. Asia (1955) 60, t. 26. — Fig. 123.

Rhizome short, forming dense tufts. *Stems* slender, erect, triquetrous, slightly scaberulous just

below the inflorescence, 10–40(–60) cm by  $1\frac{1}{2}$  mm, surrounded below the leaves by light brown, withered leaf-bases. *Leaves* subbasal, shorter to longer than the stems, flat to conduplicate, grey-green, scabrid on the margins above, long-attenuate to the triquetrous apex, 2–3(–5) mm wide. *Inflorescence* oblong, spike-like,  $2\frac{3}{4}$ –(6) cm long. *Spikelets* 4–8, gynaeandrous ( $\sigma$  part few-flowered, inconspicuous), ovoid, ellipsoid, or sub-cylindric, sessile, dense-flowered, approximate or contiguous, 6–9 by 4–5 mm. Bracts glumiform, shortly aristate, the lowest rarely subulate to subherbaceous. *Glumes* ovate, acute, very thin, whitish, 3-nerved in the centre,  $2\frac{1}{2}$  mm long, the midrib sometimes slightly excurrent. *Utricles* ovate

or ovate-elliptic, biconvex, membranous, several-nerved on both faces, scarcely marginate, glabrous or slightly papillose at the apex, golden yellow, densely whitish punctulate, straight, suberect, very shortly stipitate, 2–2½ by 1–1½ mm, scarcely beaked; mouth minutely bidenticulate. *Nut* elliptic to broadly ovate, plano-convex or biconvex, scarcely stipitate, abruptly beaked, light brown, c. 1½ by 1 mm. *Style-base* not thickened. Stigmas 2.

Distr. Widely spread in N. America, extra-tropical S. America, Eurasia (also Kashmir and Japan), and SE. Australia (New South Wales, Victoria); in *Malesia*: New Guinea (Lake Habbema in W., Neon basin 15 km NNE of Waitape in E.).

Ecol. Plentiful in open grassland on wet sandy soil and on marshy flats, 2800–c. 3225 m

Note. For the correct name of this species, which has commonly been called *C. canescens* L., see E. S. MARSHALL, J. Bot. 45 (1907) 365; S. T. BLAKE, J. Arn. Arb. 28 (1947) 101; NELMES, Reinwardtia 1 (1951) 444.

#### Doubtful (*Sect. Vigneastra*)

*Carex subflicina* OHWI, Bot. Mag. Tokyo 56 (1942) 213; NELMES, Reinwardtia 1 (1951) 446 (under doubtful species). — I did not see any collections of this species. From the description it is possibly conspecific with either *C. flicina* NEES or *C. cruciata* WAHLENB. — (NOOT.)

#### Excluded

*Carex arnotiana* NEES ex DREJER, Symb. Caric. (1844) 16, t. 5; BOECK. Linnaea 40 (1876) 436. — This species is endemic in Ceylon. BOECKELER, l.c., cited it also to occur in "Java, alt. 6000 ped. (Arnot)". As the annotation for the type specimen is exactly matching this and ARNOTT never collected in Java, this record is based on a miswritten label.

*Carex cladostachya* WAHLENB. Vet.-Ak. Handl. 24 (1803) 149; BOECK. Linnaea 40 (1876) 361; KÜK. Pfl. R. Heft 38 (1909) 267. — This Central American species was recorded by BOECKELER, l.c., also from the Philippines on the strength of CUMING 625. This specimen must certainly belong to CUMING's American collections, which were separately numbered from the Philippine ones.

*Carex dimorpholepis* STEUD. Syn. 2 (1855) 214. — *C. cernua* BOOTH, Ill. 4 (1867) 171, t. 578, non J. F. GMEL. 1791. — The old specimens of this species in the Leyden Herbarium annotated "Arch. Ind. ? Leg. ?" in all probability do not originate from the Malayan Archipelago, as they would be the only Malesian collection extant. *C. dimorpholepis* is known from India, Upper Burma, and China to Korea and Japan. See NELMES, Kew Bull. (1950) 208.

*Carex divulsa* STOKES var. *javanica* NELMES, Kew Bull. (1950) 208; Reinwardtia 1 (1951) 436. — See below under *C. pairaei*.

*Carex erythrolepis* KÜK. Pfl. R. Heft 38 (1909) 628; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 246, p. 65. — "Java, Hillebrand in herb. musei berol. sine indicatione loci." Wrongly localized; see Fl. Males. I, 1 (1950) 232. The name must be referred to the synonymy of *C. wahuensis* C. A. MEY., an endemic of the Hawaiian Islands. See NELMES, Kew Bull. (1950) 203.

*Carex haenkeana* PRESL, Rel. Haenk. 1 (1828) 205; STEUD. Syn. 2 (1855) 241; MIQ. Fl. Ind. Bat. 3 (1857) 354; F.-VILL. Nov. App. (1882) 310. — "Habitat in insulis Philippinis." This is *C. pseudocyperus* L. var. *haenkeana* (PRESL) KÜK. Bot. Jahrb. 27 (1899) 550; Pfl. R. Heft 38 (1909) 696, a S. American plant. The record attributed to the Philippines was based on an erroneously localized Malaspina Expedition specimen. See MERRILL, En. Philip. 1 (1923) 142.

*Carex lindleyana* NEES in Wight, Contr. (1834) 121; BOECK. Linnaea 40 (1876) 362; KÜK. Pfl. R. Heft 38 (1909) 280. — This is a species from the Deccan Peninsula and Ceylon. BOECKELER recorded it besides from the Philippines on the strength of an unnumbered collection of CUMING. If correctly identified this certainly rests on an erroneous localisation; it might have been collected in Ceylon by CUMING himself.

*Carex pairaei* F. SCHULTZ var. *javanica* NELMES, Kew Bull. (1950) 208; Reinwardtia 1 (1951) 437.

*Carex divulsa* STOKES and *C. muricata* L. (= *C. pairaei* F. SCHULTZ) were recorded by NELMES from Java, the only ones from outside Europe, both based on a single specimen, that of *C. divulsa* even on a single culm. The scanty materials were alleged to have been collected by RIDLEY during his Java tour on Mt Papandajan.

However, there is no doubt that the specimens were mislocalized, possibly by using drying paper to which remnants of rambles in Europe adhered. The *Carex* flora of the easily accessible Mt Papandajan is well known, e.g. by the intensive search for *Carices* by VAN STEENIS.

Similar records opposing all rules of plant distribution are those of *Elisma natans* for Java, *Linaria alpina* for the Malay Peninsula, and *Scheuchzeria palustris* for Sumatra (see Taxon 5, 1956, 157). NELMES, in litt. Dec. 17, 1953, admitted that the records must be due to an error.

*Carex scabrifolia* STEUD. Syn. 2 (1855) 237; MIQ. Fl. Ind. Bat. 3 (1857) 354. — "Carex nr 67 et 83. Herb. Zollinger. Java." The type is not from Java, but from Japan, Decima in Nagasaki. See ZOLL.



Syst. Verz. 1 (1854) 60; KÜK. Pfl. R. Heft 38 (1909) 737; KOYAMA, J. Fac. Sc. Un. Tokyo III, 8 (1962) 248. — HUBERT WINKLER 2097, wrongly distributed as *C. scabrifolia*, belongs to *C. baccans* NEES.

*Carex typhoides* BORY; HASSK. Cat. Bog. 296; Miq. Fl. Ind. Bat. 3 (1857) 352. — This is *C. borbonica* LAMK from the Mascarenes; certainly not occurring in Malesia.

## 29. UNCINIA

PERS. Syn. Pl. 2 (1807) 534; BOECK. Linnaea 41 (1877) 339; CLARKE, J. Linn. Soc. Bot. 20 (1883) 389; KÜK. Pfl. R. Heft 38 (1909) 50; NERMES, Kew Bull. (1949) 140; HAMLIN, Dom. Mus. Bull. 19 (1959) 1; BALGOOY, Pac. Pl. Areas 3 (1975) 320, map 209; NOOT. Blumea 24 (1979) 511. — **Fig. 137a-d.**

Perennial, monoecious herbs, glabrous (or with hispid utricles). *Stems* central, tufted or approximate on a more or less creeping rhizome, erect or ascendent, sharply trigonous to subterete, striate, smooth, or scabrid below the inflorescence. *Leaves* narrowly linear, flat or involute, more or less scabrid on margins and nerves; basal sheaths bladeless, often disintegrating into fibres. *Inflorescence* a single, terminal spikelet; ♂ part above, shorter than the lower ♀ part. *Glumes* spirally arranged, ovate to oblong, concave, persistent or caducous, all flower-bearing, the lowest often produced into a setaceous to foliaceous bract. — ♂ *Flowers* naked, consisting of (1-)2-3 stamens with linear (or dilated, New World *spp.*) filaments and linear anthers; connective shortly produced. — ♀ *Flowers* naked, enclosed in a bottle-shaped, obtusely trigonous organ (utricle, perigynium) which is closed up to the truncate top, glabrous (in all Mal. and Austr. *spp.*) or hispid; style incrassate at the base; stigmas 3, exserted from the utricle. *Rachilla* (see note) reduced to a rigid bristle below the nut and produced far beyond the mouth of the utricle, hooked at the top. *Nut* trigonous.

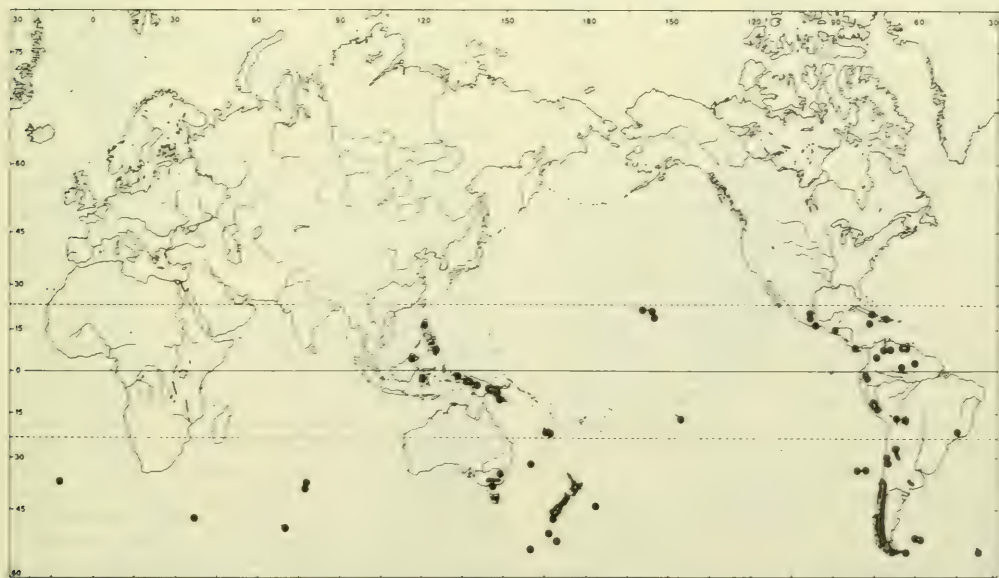


Fig. 136. Range of the genus *Uncinia* PERS. (from VAN BALGOOY, Pac. Pl. Areas 3, 1975, 320, map 209)

Distr. A genus of probably Antarctic origin, with wide southern distribution; from the extreme south of S. America including the Falkland Is., along the Andes to Mexico and Jamaica; islands in the southern parts of the Atlantic and of the Indian Ocean; from Tasmania through E. Australia northwards to *Malesia*, Mt Pulog in the Philippines being the most northern extension; highly developed in New Zealand and neighbouring islands, from there one species extending to Hawaii. Fig. 136.

Note. *Subdivision of the genus*. KÜKENTHAL divided *Uncinia* into two subgenera, *Uncinia* ('*Eu-Uncinia*') and *Pseudocarex*, the latter containing only *U. kingii* BOOTT from Antarctic S. America, in which the rachilla is but shortly hooked. *Subg. Uncinia* is divided into two sections which are to some extent also geographically defined: *sect. Uncinia*, mainly Australian with few species in S. America, and *sect. Platyantha* which is exclusively American.

## KEY TO THE SPECIES

1. Glumes persistent. Stems sharply trigonous, scabrid beneath the inflorescence . . . . . 1. *U. riparia*  
 1. Glumes caducous, when young often an abscission layer visible. Stems obscurely trigonous . . . . . 2. *U. compacta*

1. *Uncinia riparia* R. BR. Prod. (1810) 241; BOOTT in Hook. f. Fl. Tasmania 2 (1860) 102, t. 152 f. B; BENTH. Fl. Austr. 7 (1878) 434; CLARKE, J. Linn. Soc. Bot. 20 (1883) 392, *excl. var.*; KÜK. Pfl. R. Heft 38 (1909) 63, *excl. var.*; S. T. BLAKE, J. Arn. Arb. 35 (1954) 234; NOOT. Blumea 24 (1979) 513. — *Carex riparia* (R. BR.) POIR. in Lamk, Enc. Méth. Suppl. 3 (1813) 282. — *U. sclerophylla* NELMES, Kew Bull. (1949) 143. — *U. ohwiana* KOYAMA, Bot. Mag. Tokyo 69 (1956) 214, f. 6.

Rhizome more or less creeping. Stems approximate on the rhizome, very slender, sharply trigonous, scabrid in the upper half, (10–)40–75 cm by  $1\frac{1}{2}$ –1 mm. Leaves from slightly shorter to slightly longer than the stems, rigid, flat or canaliculate, long attenuate, scabrous on margins and nerves in upper half,  $1\frac{1}{2}$ –3(–?)4 mm wide; basal sheaths bladeless or short-bladed, fuscous. Spikelet narrowly linear, often very loosely flowered, ebracteate or with a filiform bract usually not overtopping the inflorescence, 3–7(–15) by 2–5 mm, the ♂ part few-flowered, 1– $1\frac{1}{2}$ (–2) cm long. Glumes persistent, oblong-ovate, acute, muticous, rigid, stramineous with broad 3-nerved green centre and sometimes brown margins, (4–)5–6(–78 $\frac{1}{2}$ ) mm long, the midrib not reaching the apex. Utricles slightly exceeding the glumes, erect, linear-oblong or linear-lanceolate, compressed-trigonous, glabrous and smooth, fine-nerved, stramineous, 6–7 by c. 1 mm, at the base subgradually narrowed into a c.  $1\frac{1}{2}$  mm long stipe, at the apex into a c.  $1\frac{1}{2}$  mm long, compressed-conical beak with narrow, hyaline mouth. Nut narrow ellipsoid.

Distr. New Zealand, Tasmania, SE. Australia (Victoria, Upper Hume R. and Mt Kosciusko, according to BENTHAM, l.c.; no specimens seen); in *Malesia*: New Guinea (West Irian, summit of Mt Wilhelmina; Papua New Guinea).

Ecol. In shaded places, usually between moss on the floor of the mossy or subalpine forest, 3000–4100 m, above 4000 m also in grassland with shrubs. Fl. fr. Jan.–Dec.

Note. Whether the glumes are persistent or caducous can often only be seen in old inflores-

cences. It is not impossible that hybrids occur with *U. compacta*, thus giving more variability and plants in which the glumes fall very late. In these plants the sharply triquetrous culms become more or less rounded and smooth instead of scabrous (not found in *Malesia*).

2. *Uncinia compacta* R. BR. Prod. (1810) 241; BOOTT in Hook. f. Fl. Tasmania 2 (1860) 103; F.V.M. Fragm. 8 (1874) 152; BENTH. Fl. Austr. 7 (1878) 434; CLARKE, J. Linn. Soc. Bot. 20 (1883) 395; CHEESEMAN, Man. New Zeal. Fl. (1906) 800; KÜK. Pfl. R. Heft 38 (1909) 65; CHEESEMAN, Man. New Zeal. Fl. ed. 2 (1925) 245; LOURTEIG, Bull. Com. Nat. Fr. Rech. Antarct. (1968) 25; NOOT. Blumea 24 (1979) 515. — *Carex compacta* POIR. in Lamk, Enc. Méth. Suppl. 3 (1813) 282. — *U. rupestris* RAOUL, Ann. Sc. Nat. III, 2 (1844) 117; BOOTT in Hook. f. Fl. Nov. Zel. 1 (1853) 286; CLARKE, J. Linn. Soc. Bot. 20 (1883) 392; KÜK. Pfl. R. Heft 38 (1909) 64, *incl. var. capillacea* KÜK.; HAMLIN, Dom. Mus. Bull. 19 (1959) 39. — *U. filiformis* BOOTT in Hook. f. Fl. Nov. Zel. 1 (1853) 286; HAMLIN, Dom. Mus. Bull. 19 (1959) 43. — *U. nervosa* BOOTT in Hook. f. Fl. Tasmania 2 (1860) 102. — *U. riparia* R. BR. var. *stolonifera* KÜK. & STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 213. — *U. riparia* (non R. BR.) OHWI, Bot. Mag. Tokyo 56 (1942) 213. — *U. subtrigona* NELMES, Kew Bull. (1949) 144. — Fig. 137a–d.

Plant laxly to densely caespitose or with short rhizome and stems densely tufted, erect; sometimes stems decumbent, forming new tufts; culms slender, rarely more than 1 mm thick, obscurely trigonous, smooth, 5–45 cm. Leaves shorter or longer than stems, flat, involute, convolute or conduplicate, sometimes (var. *nervosa*) plano-convex and then often canaliculate, long attenuate, scabrous on margins and nerves at least in upper half,  $\frac{1}{4}$ –3 mm wide, the tip mostly rather acute, triquetrous, rarely flat or plano-convex and blunt (var. *nervosa*); basal sheaths bladeless, brown. Spikelets narrowly oblong, loosely to very densely flowered, sometimes bracteate, (1–) $1\frac{1}{2}$ – $5\frac{1}{2}$  cm by  $2\frac{1}{2}$ –



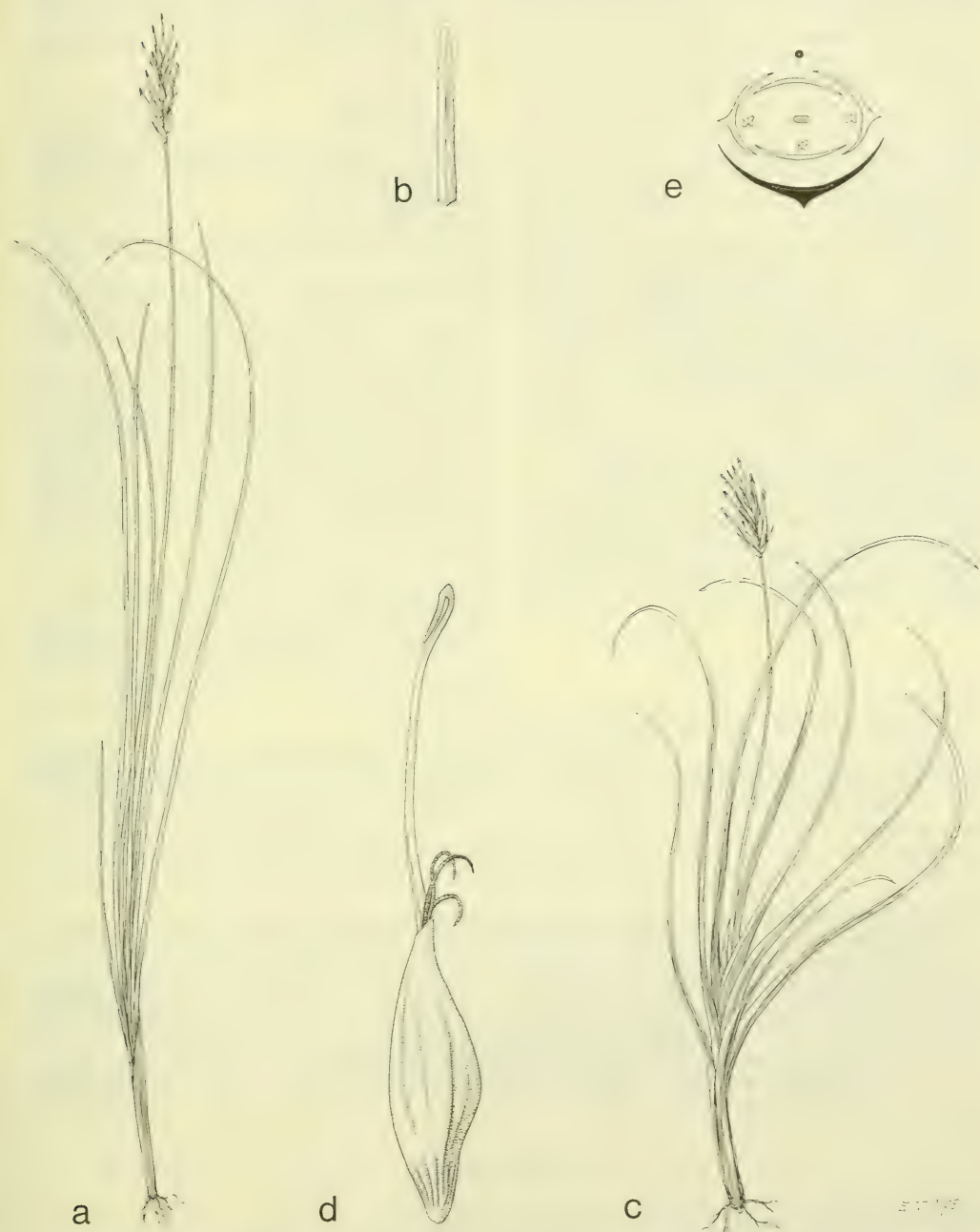


Fig. 137. *Uncinia compacta* R. BR. var. *nervosa* CLARKE. *a.* Habit, nat. size, *b.* leaf tip,  $\times 7$ . — *U. compacta* R. BR. var. *alpina* NOOT. *c.* Habit, nat. size, *d.* utricle,  $\times 10$ . — *Exocarya scleroides* (F.v.M.) BENTH. *e.* Flower diagram (*a-b* ANU 7161, *c-d* ANU 7289).

20 mm, the ♂ part  $1\frac{1}{2}$ – $1\frac{1}{2}$  cm long. *Glumes* caducous, when young the abscission line often already visible, oblong-ovate or lanceolate, acute, muticous, at least the margins hyaline, greenish or brown, with 3-nerved central stripe but often with several more nerves, 4–6(–8 mm in the Antarctic Is.) by 1.6–3 mm. *Utricles* shorter to slightly longer than glumes, obliquely erect to patent, lanceolate elliptic or ovoid, with 2 conspicuous submarginal nerves, sometimes slenderly nerved towards the base or striate when these nerves are prolonged,  $3\frac{1}{2}$ –6(–7) by 1–2 mm, at the base contracted into a  $1\frac{1}{2}$  mm long stipe, at the apex (gradually) narrowed into a 1–2 mm long beak. *Nut* ellipsoid.

Distr. Australia (Victoria, New South Wales, Tasmania), New Zealand, Amsterdam I., Kerguelen, Crozet, Marion, Gough and Tristan da Cunha; in *Malesia*: Philippines (Luzon: Mts Pulog & Banahao; Mindanao: Mt Apo), N. Borneo (Mt Kinabalu), Celebes (Latimodjong Mts), New Guinea.

Ecol. In the tropics in the high mountains, 2000–4300 m, outside the tropics in temperate and cold climates, in open places and in forest.

Note. The second character in the key to the species differentiating *U. compacta* from *U. riparia* breaks partly down in some specimens from Victoria and New South Wales; these specimens have a sharply triquetrous and (interruptedly) scabrous stem.

#### KEY TO THE VARIETIES

1. Spikelets c. 1 cm long. Leaves strongly circinnate towards the apex. Usually small plants  
c. var. *alpina*
1. Spikelets  $1\frac{1}{2}$ – $5\frac{1}{2}$  cm. Leaves not or less circinnate. Plants often larger.

2. Leaves flat (always in New Guinea), involute, convolute or conduplicate with acute, trigonous or triquetrous tip. . . . a. var. *compacta*
2. Leaves plano-convex with flat, or plano-convex blunt tip. . . . b. var. *nervosa*

#### a. var. *compacta*.

Spikelets  $1\frac{1}{2}$ – $5\frac{1}{2}$  cm. Leaves flat, involute, convolute or conduplicate. Leaf tip acute, trigonous or triquetrous, undulate or (somewhat) circinnate.

Distr. As the species.

Ecol. In forest, 2000–3700 m. *Fl. fr.* Jan.–Dec.

b. var. *nervosa* CLARKE, J. Linn. Soc. Bot. 20 (1883) 395. — *U. nervosa* BOOTT in Hook. f. Fl. Tasmania 2 (1860) 102; HAMLIN, Dom. Mus. Bull. 19 (1959) 50. — Fig. 137a–b.

Spikelets  $1\frac{1}{2}$ –3 cm. Leaves plano-convex, usually canaliculate, sometimes some of the leaves convolute. Leaf tip flat, or plano-convex, blunt.

Distr. Australia (New South Wales, Kosciuszko area and Tasmania), New Zealand; in *Malesia*: New Guinea.

Ecol. In open places, mostly in grassland, 3000–4026 m. *Fl. fr.* June–Nov.

c. var. *alpina* NOOT. Blumea 24 (1979) 519. — Fig. 137c–d.

Spikelets c. 1 cm long. ♀ Flowers c. 5; utricles  $3\frac{1}{2}$ –4 mm. Leaves involute, strongly circinnate towards the triquetrous or trigonous apex.

Distr. *Malesia*: New Guinea (Mt Wilhelm and Mt Giluwe).

Ecol. In exposed places, often temporarily covered by snow, also on solifluction terraces, 3770–4350 m. *Fl. fr.* Nov.–April.

#### ADDENDA

7: 452 Add to A. SUBFAMILY CYPEROIDEAE I. *Tribe Hypolytreae* after 6. *Paramapania*: 6a. *Exocarya*.

Change in the SYNOPTICAL KEY TO THE MALESIAN GENERA fork 6, second lead, into:

6. Hypogynous scales 2 or 4.

6'. Hypogynous scales 2. . . . . 7. *Hypolytrum*

6'. Hypogynous scales 4. . . . . 6a. *Exocarya*

7: 454 Change in the KEY TO THE GENERA fork 19, first lead, into:

19. Hypogynous scales 2 or 4. Stigmas 2. Inflorescence paniculate.

19'. Hypogynous scales 2, either of them with a stamen in its axil . . . . . 7. *Hypolytrum*

19'. Hypogynous scales 4, stamens 3 . . . . . 6a. *Exocarya*

#### 6a. EXOCARYA

BENTH. in Hook. Ic. Pl. 3 (1877) pl. 1206. — Fig. 137e.

*Leaves* situated throughout the stem. *Inflorescence* an umbellate panicle, the lower 2–3 bracts long, foliaceous. *Spikelets* small, the upper 1 or 2 flowers bisexual, the other 2–3 flowers male. *Glumes* imbricate, the lower ones often empty. *Flowers*



compressed, the 2 outer hypogynous scales subopposite, folded, transverse and sharply keeled, the 2 inner ones flat or concave, parallel with the glumes. *Stamens* 3. *Style* broadened towards the base, with 2 filiform stigmas. *Nut* exerted from the glumes, crowned by the persistent style-base.

Distr. Monotypic. Australia (Queensland, New South Wales); in *Malesia*: E. New Guinea (Ferguson I.).

1. *Exocarya scleroides* (F.v.M.) BENTH. in Hook. Ic. Pl. 3 (1877) pl. 1206; F. M. BAILEY, Queensl. Fl. 6 (1902) 1777; S. T. BLAKE, Proc. R. Soc. Queensl. 54 (1943) 72. — *Cladium scleroides* F.v.M. Fragm. 9 (1875) 12. — *Scleria ustulata* F. M. BAILEY, 3rd Suppl. Syn. Queensl. Fl. (1890) 81. — *E. montivaga* DOMIN, Bibl. Bot. XX, Heft 85 (1915) 484. — Fig. 137e.

*Stems* from a creeping rhizome, to c. 1 m high, foliaceous, 3-angled. *Leaves* flat, to 6½ mm broad, tapering into long subulate points; sheaths close, with minutely fimbriate mouth. *Inflorescence* an umbellate panicle, varying in size, but often very large, to 20 cm Ø, the longest rays up to 15 cm, pedicels filiform. Involucral bracts several, foliaceous, the longest scarcely as long as the inflorescence. *Spikelets* dark brown, narrowly obovate, c. 4 mm long. Lower *glumes* empty, outer ones very short, c. 1 mm, gradually passing into the c. 2 mm long flowering ones. Hypogynous scales as long as the glumes. *Nut* much exerted, ovoid-oblong (or globose; '*E. montivaga*'), c. 4 mm long,

smooth, the remains of the spikelet forming a small tuft at its base. *Style-base* black, larger than the ovary at the time of flowering but not enlarged afterwards.

Distr. E. Australia (New South Wales, Queensland); in *Malesia*: Papua New Guinea (once collected in Ferguson I.).

Ecol. In forest, 720 m. *Fl. fr.* Nov.

Although sometimes rather abundant, its occurrence in Australia is very sporadic over its rather extensive geographical range. It seems to be usually a constituent of some of the less densely closed forests.

A notable feature is that only a small proportion of the spikelets produce mature nuts (BLAKE, *l.c.*).

Note. This plant belongs to the tribe *Hypolytrae* and is obviously intermediate between *Paramapania* and *Hypolytrum*, differing from the former in the presence of only 2 interior, flat hypogynous scales, while *Hypolytrum* lacks those scales. The stomata are tetracytic, as in *Lepironia* and *Scirpodendron*.

#### Excluded

*Eriophorum comosum* (WALL. in Roxb.) NEES in Wight, Contr. (1837) 110; Miq. Fl. Ind. Bat. 3 (1856) 330; STEEN. Bull. Jard. Bot. Btzg III, 13 (1933) 200.

MIQUEL cited this to occur in Malaya (Penang I.); on what grounds is uncertain. It must be a mystification or mislocalisation of specimens. CLARKE (1893) did not mention this locality in Fl. Br. Ind.

In Herbarium Bogoriense VAN STEENIS, *l.c.*, found specimens of *E. comosum*, said to have been collected in Karimata I. (off W. Borneo), mixed with specimens of *Machaerina rubiginosa*. This was interpreted as an unintentional mixture; *E. comosum* certainly does not occur in the low Karimata I.

*Eriophorum filamentosum* BOECK. Bot. Jahrb. 5 (1884) 506 was based on a GRIFFITH collection credited to have been collected in Malaya.

CLARKE (Fl. Br. Ind. 6, 1893, 664) reduced this to *Xerotes leucocephala* R. BR., of which *Xerotes filamentosa* A. CUNN. msc. is a synonym. This is not a Cyperaceous plant, but belongs to *Lomandra* of the *Liliaceae sens. lat.*, a genus which occurs outside Australia only in New Guinea. It is hard to believe that BOECKELER made such an error. This may be a slip of the pen by CLARKE.

The identity of BOECKELER's type should still be checked; but no *Eriophorum* has ever been found in Malaya.





## LILIACEAE—I (J. P. Jessop, Adelaide)<sup>1</sup>

Herbs, usually glabrous, with perennial underground stems (corms, bulbs, tubers, or rhizomes) in all *Mal. spp.* Aerial stems usually herbaceous and annual, erect or climbing. *Leaves* simple, caespitose and basal, sometimes distichous, if cauline usually alternate, generally linear to lanceolate or oblanceolate especially when basal, but sometimes shorter and broader (to ovate) when cauline, usually sessile (in *Asparagus* and *Petrosavia* reduced to non-photosynthetic scales), usually with parallel venation. Stipules 0. *Inflorescence* terminal or axillary, usually racemose (less often at least partly umbellate) or flowers solitary, usually bracteate. *Flowers* bisexual (except, in *Mal.*, *Asparagus cochinchinensis* and *Astelia alpina*), usually actinomorphic. *Perianth segments* almost invariably 6 in two more or less similar or less often distinctly dissimilar whorls of 3, petaloid, connate or free, the outer whorl sometimes saccate at the base. *Stamens* 6, inserted on receptacle or perianth; filaments connate or free, rarely forming a corona-like ring attached to the perianth; anthers basifixed or dorsifixed, rarely sessile, usually 2-celled, extrorse to introrse or rarely dehiscent by an apical pore. *Ovary* usually superior, of 3 (usually fused) carpels; styles 1 or 3, simple or 3-branched; locules usually 3 (1 in *Tricalistra*); ovules 1 to numerous, placentation axile, rarely basal or parietal, usually in 2 rows. *Fruit* usually a loculicidal or septicidal capsule or berry, rarely the ovary wall ruptured by the developing seed which develops unprotected by a fruit, perianth caducous or persistent. *Seeds* with copious fleshy or cartilaginous endosperm.

**Distribution.** About 180 genera with approximately 3500 *spp.*, distributed all over the world, especially in the temperate regions of Asia, Australasia and Africa, but relatively poorly represented in South America (13 genera).

In *Malesia* 22 genera, with a total of 31 *spp.*, no genus being represented by more than two species. The only genus endemic to the region is the Malayan genus *Tricalistra* whose separation from *Tupistra* is, however, somewhat uncertain. Most other genera are represented in *Malesia* by a minority of their species, exceptions being *Gloriosa* and *Peliosanthes*, which are probably both monotypic, and *Petrosavia*, which consists probably of two species.

The genera can roughly be arranged into three geographical groups.

Old World genera are *Asparagus*, *Chlorophytum*, *Dianella*, *Gloriosa* and *Iphigenia*, among which *Chlorophytum* is mainly Africa-centred, and *Dianella* mostly Australasian.

Northern hemisphere genera, especially from the Far East, Sino-Himalayan, are the following: *Alettris*, *Disporopsis*\*, *Disporum*, *Lilium*\*, *Liriope*\*, *Ophiopogon*, *Peliosanthes*, *Petrosavia*, *Tricyrtis*\*, and *Tupistra*. Of these four, provided with an asterisk, are found only in *Malesia* in the Philippines, and *Tupistra* only in Malaya and Sumatra. All of them are absent from East *Malesia*. Most of their species occur in the montane zone, testimony of their subtemperate ecology.

Australasia-derived genera are *Arthropodium*, *Astelia*, *Caesia*, *Schelhammera*, *Thysanotus*, and *Tricoryne*. Their occurrence in *Malesia* is confined to New Guinea, except for *Thysanotus chinensis* BTH. which is found through *Malesia* as far as Thailand and S. China. Their ranges are sometimes wider in Austral regions, as *Arthropodium* and *Caesia* occur also in the Malagasy area, and *Caesia* also in South Africa, while *Astelia* ranges widely from Mauritius to the southern Pacific islands and the Falkland Islands. Except for *Astelia*, which occurs in *Malesia* only in the

(1) Gratefully acknowledging a stipend from C.S.I.R., Pretoria, for work on this revision during the period July 1973 to June 1974, at the Rijksherbarium, Leyden, when on long-leave from Rhodes University, Grahamstown, South Africa.

With bibliographic co-operation of the General Editor.

alpine zone of New Guinea, all the species of the genera of this southern group are bound to lowland drought habitats.

**Ecology.** Of the 22 genera 13 are integrated in lowland to montane everwet-forest conditions. *Astelia alpina* is a high-altitude cushion plant which sometimes plays a significant role in the alpine bogs of New Guinea. The eight other genera, *Arthropodium*, *Asparagus*, *Caesia*, *Gloriosa*, *Iphigenia*, *Schellhammera*, *Thysanotus*, and *Tricoryne*, are constituents of areas subject to a seasonal climate. Consequently, the ranges of *Asparagus racemosus*, *Gloriosa superba*, *Iphigenia indica* and *Thysanotus chinensis* show in Malesia the usual disjunctions of drought-preferring plant species. They are predominantly grassland or open savannah plants at low altitudes. Most of them are Australasia-centred.

Except for *Astelia papuana*, species of these *Liliaceae sensu stricto* do not form major constituents or natural communities.

**Dispersal.** The great majority of *Liliaceae* spread and reproduce vegetatively by the branching of their subterranean axes. In most species this appears to be a slow process, with the branches often not extending more than a few centimetres in a year. It may, however, result in fairly dense monospecific stands, for example, in *Astelia* and *Liriope*.

Fruits are generally capsules or berries. In the former, dispersal mechanisms do not usually result in the removal of seeds to any great distance, although wind and water can contribute significantly.

Birds are probably the most efficient vectors over longer distances. Several genera have fleshy fruits and two (*Ophiopogon* and *Peliosanthes*) have a fleshy coating to the seeds, which are exposed through rupture of the ovary wall. Mammals may also disperse the seeds by eating the fruits. *Liliaceae* seeds in other areas are known to be carried by ants if there is a substance attractive to ants (often oil bodies) in the testa or fruit. Specific data on the Malesian species have not, however, been found.

For a study of the structure and relationships of the seeds, see HUBER, Die Samenmerkmale und Verwandtschaftsverhältnisse der Liliifloren, Mitt. Bot. Staatssamml. Münch. 8 (1969) 219–538.

**Cytology.** *Liliaceae*, because of the usually large size of their chromosomes, because of the ease with which material can often be obtained at the stages of division required for study, and because many species are in cultivation, have been fairly well studied cytologically. Chromosome numbers, and even basic chromosome numbers vary widely sometimes within, as well as between, genera. At least six different somatic numbers have, for example, been reported for *Disporum*, based on  $x = 6, 7, 8, 9$  and  $11$ . Other genera, for example, *Asparagus* ( $x = 10$ ) and *Dianella* ( $x = 8$ ), have relatively stable basic numbers, although polyploidy may be common.

**Taxonomy.** The family *Liliaceae*, in the sense of BENTHAM & HOOKER and of KRAUSE in E. & P. Nat. Pfl. Fam. is a very large and rather heterogeneous one including possibly as many as 3500 species. Many more recent authors have attempted to distribute these species over a larger number of families. In this treatment the family delimitation of HUTCHINSON (Families of flowering plants, ed. 3, 1973) has been adopted, with two modifications: the inclusion of *Petrosavia* which HUTCHINSON placed in its own family, and of the naturalised *Nothoscordum* which HUTCHINSON placed in the *Amaryllidaceae*. It is very doubtful if the family is more naturally defined by excluding a number of genera represented in Malesia, as HUTCHINSON has done, but this has been followed here as much for the convenience of dealing with smaller families as for any conviction that these families have any botanical significance. Table 1 indicates the genera retained in the *Liliaceae* and the families to which other genera, sometimes included in the *Liliaceae*, were ascribed by HUTCHINSON. These families have also been included in the key to the genera of Malesian *Liliaceae*.

Much work remains to be done on the relationships of Liliaceous genera and HUTCHINSON's work, although the most recent, is probably no better than KRAUSE's. HUTCHINSON's placing of *Ophiopogon* and *Peliosanthes* in separate tribes is, for example, almost certainly unjustified.

**Uses.** Several species of *Liliaceae* native to Malesia have been taken into cultivation as garden ornamentals, for example of the genera *Dianella*, *Gloriosa*, *Lilium*, *Liriope*, and *Ophiopogon*. Other uses are, however, rather few. Several genera, for example, *Asparagus*, *Gloriosa*, *Ophiopogon*, have been used in traditional medicines but they have not contributed to modern



Table 1. Malesian Liliaceous genera in the classification by KRAUSE (1930), first column, and by HUTCHINSON (1973), third column.

Subfamily I.	<i>Melanthioideae</i>		
I.	2. <i>Petrosavieae</i>	— <i>Petrosavia</i>	( <i>Petrosaviaceae</i> )
I.	6. <i>Uvularieae</i>	— <i>Schelhammera</i> — <i>Gloriosa</i>	} <i>Uvularieae</i>
I.	7. <i>Tricyrteae</i>	— <i>Tricyrtis</i>	
I.	8. <i>Anguillarieae</i>	— <i>Iphigenia</i>	<i>Iphigenieae</i>
Subfamily III.	<i>Asphodeloideae</i>		
III.	11. <i>Asphodeleae</i>	— <i>Chlorophytum</i> — <i>Thysanotus</i>	} <i>Asphodeleae</i>
III.	11a. <i>Asphodelinae</i>	— <i>Arthropodium</i>	
		— <i>Tricoryne</i>	<i>Johnsonieae</i>
		— <i>Caesia</i>	<i>Asphodeleae</i>
III.	11g. <i>Dianellinae</i>	— <i>Stypandra</i> — <i>Dianella</i>	} <i>Dianelleae</i>
III.	17. <i>Lomandreae</i>	— <i>Lomandra</i> — <i>Romnaldia</i>	
			( <i>Xanthorrhoeaceae</i> )
Subfamily IV.	<i>Allioideae</i>	— <i>Nothoscordum</i> (introduced)	( <i>Amaryllidaceae</i> )
Subfamily V.	<i>Lilioideae</i>	— <i>Lilium</i>	<i>Tulipeae</i>
Subfamily VII.	<i>Dracaenoideae</i>		
VII.	27. <i>Dracaeneae</i>	— <i>Cordyline</i> — <i>Dracaena</i>	} ( <i>Agavaceae</i> )
		— <i>Astelia</i>	
			<i>Milliganieae</i>
Subfamily VIII.	<i>Asparagoideae</i>		
VIII.	28. <i>Asparageae</i>	— <i>Asparagus</i>	<i>Asparageae</i>
VIII.	29. <i>Polygonatae</i>	— <i>Disporum</i> — <i>Disporopsis</i>	} <i>Polygonatae</i>
VIII.	30. <i>Convallarieae</i>	— <i>Tupistra</i> — <i>Tricalistra</i>	
			<i>Aspidistreae</i>
Subfamily IX.	<i>Mondoideae</i>	— <i>Liriope</i> — <i>Ophiopogon</i>	} <i>Ophiopogoneae</i>
		— <i>Peliosanthes</i>	
			<i>Peliosantheae</i>
Subfamily X.	<i>Aletroideae</i>	— <i>Aletris</i>	<i>Narthecieae</i>
Subfamily XI.	<i>Luzuriagoideae</i>	— <i>Luzuriaga</i> — <i>Geitonoplesium</i> — <i>Eustrephus</i>	} ( <i>Philesiaceae</i> )
Subfamily XII.	<i>Smilacoideae</i>	— <i>Rhipogonum</i> — <i>Smilax</i> — <i>Heterosmilax</i>	} ( <i>Smilacaceae</i> )

medicine. Others have edible underground parts (e.g. *Arthropodium*) or fruits (e.g. *Astelia*), but none is probably of great significance.

Notes. A very large number of exotic *Liliaceae* are recorded to be or have been cultivated in gardens in Malesia. They have been treated elaborately, with keys for their identification by C. A. BACKER in his 'Handboek voor de Flora van Java', part 3 (1924), in Dutch, and by C. A. BACKER & R. C. BAKHUIZEN VAN DEN BRINK Jr in their 'Flora of Java', volume 3 (1968), in English.

Only one exotic, *Nothoscordum inodorum*, has been introduced and has run wild in West Java; this has been incorporated in the treatment.

Almost all drawings were made by Mr. L. DUTKIEWICZ, Adelaide.

#### KEY TO THE GENERA

*including the families sometimes segregated from Liliaceae sensu lato*

1. Leaves reduced to small, non-photosynthetic scales.
  2. Stem branched, bearing green cladodes . . . . . 13. *Asparagus*
  2. Stem simple. Small echlorophyllous saprophyte . . . . . 4. *Petrosavia*
1. Leaves usually well-developed, always green (sometimes absent when the plant is in flower).
  3. Anthers 1-celled. Plants usually woody and often prickly climbers (*Heterosmilax*, *Rhipogonum*, *Smilax*) . . . . . Smilacaceae
  3. Anthers 2-celled. Plants erect or herbaceous, not prickly, rarely woody climbers.
    4. Plants dioecious.
      5. Panicle glabrous or scaberulous. Flowers clustered at all or most nodes (*Lomandra*) . . . . . Xanthorrhoeaceae
      5. Panicle silvery-scaly. Flowers solitary at each node . . . . . 22. *Astelia*
    4. Flowers bisexual.
      6. Foliage leaves caespitose, usually basal or radical.
        7. Inner perianth segments fringed . . . . . 10. *Thysanotus*
        7. Perianth segments not fringed.
          8. Inflorescence a simple umbel. Bulbous . . . . . 23. *Nothoscordum*
          8. Inflorescence a raceme, spike or panicle. Plant rhizomatous.
            9. Flowers sessile. Anthers sessile or subsessile on the perianth.
              10. Fruit a capsule . . . . . 21. *Aletris*
              10. Fruit fleshy.
                11. Style distinct. Stigma simple or indistinctly lobed . . . . . 17. *Tupistra*
                11. Style absent. Stigmas distinctly 3 . . . . . 16. *Tricalistra*
    9. Flowers pedicelled. Filaments usually well-developed.
      12. Seeds fleshy and exposed soon after the commencement of their development.
        13. Filaments free of one another. Corona absent . . . . . 18. *Liriope*
        13. Filaments connate or anthers sessile on a staminal corona.
          14. Anthers borne on a distinct staminal corona. . . . . 20. *Peliosanthes*
          14. Anthers borne on connate filaments . . . . . 19. *Ophiopogon*
      12. Seeds retained in the fruit until mature.
        15. Anthers dorsifixed.
          16. Ovary half-inferior . . . . . 21. *Aletris*
          16. Ovary fully superior.
            17. Fruit a capsule. Stems to 5 cm long and 2-3 mm diameter (*Romnaldia*) . . . . . Xanthorrhoeaceae
            17. Fruit a berry. Stems woody and usually long (*Dracaena*, incl. *Pleomele*) . . . . . Agavaceae
  15. Anthers basifixed.
    18. Fruit a berry . . . . . 9. *Dianella*
    18. Fruit a capsule.
      19. Base of anthers with a papillose appendage. Pedicels 12-20 mm. Outer perianth segments distinctly broader than inner ones . . . . . 6. *Arthropodium*
      19. Base of anthers without appendages. Pedicels 3-12 mm. Perianth segments equal.
        20. Perianth spirally twisting after anthesis, blue . . . . . 7. *Caesia*
        20. Perianth segments persistent, but not twisted after flowering, white to green . . . . . 8. *Chlorophytum*
6. Foliage leaves distributed at intervals along the stem.
  21. Plant with scaly bulb. Flowers 10-25 cm long . . . . . 12. *Lilium*



- 21. Plant with a rhizome, corm or tuber. Flowers up to at most 9 cm.
- 22. Stem(s) woody. Venation reticulate (*Eustrephus*, *Geitonoplesium*) . . . . . **Philesiaceae**
- 22. Stem(s) herbaceous. Venation parallel.
- 23. Style simple, or if 3 lobed the filaments forming a corona.
- 24. Fruit a berry. Inflorescence a panicle . . . . . **9. Dianella**
- 24. Fruit consisting of 1–3 nutlets. Inflorescence consisting of umbels each on a winged peduncle . . . . . **11. Tricoryne**
- 23. Style branched, sometimes to the base.
- 25. Flowers large, 5–9 cm. At least some leaves ending in a coiled tendril . . . . . **1. Gloriosa**
- 25. Flowers smaller, up to 3 cm. Leaves never ending in a tendril.
- 26. Filaments expanded to form a corona. Fruit a berry . . . . . **15. Disporopsis**
- 26. Filaments free, sometimes connivent.
- 27. Fruit a berry . . . . . **14. Disporum**
- 27. Fruit a capsule.
- 28. Pedicels not articulated. Anthers dorsifixed.
- 29. Rootstock a rhizome. Style branches bifid . . . . . **2. Tricyrtis**
- 29. Rootstock a corm. Style branches simple . . . . . **3. Iphigenia**
- 28. Pedicels articulated. Anthers basifixed . . . . . **5. Schelhammera**

1. GLORIOSA

LINNÉ, Sp. Pl. (1753) 305; Gen. Pl. ed. 5 (1754) 144; BAKER, J. Linn. Soc. Bot. 17 (1879) 457; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 266; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 606; FIELD, Kew Bull. 25 (1971) 243; Lilies and other *Liliaceae* 1973 (1972) 93. — *Methonica* TOURN. ex CRANTZ, Inst. rei herb. 1 (1766) 474. — **Fig. 1, 2.**

Climbing, or less often erect, glabrous herbs. *Rhizome* perennial, tuberous, horizontal; roots fibrous. Aerial stem annual, moderately branched; the branches spreading or erect-spreading at the base. *Leaves* cauline, alternate, opposite or in whorls of 3 (4), flat, with many veins and a strong midrib, sessile, entire, lanceolate to ovate, slightly amplexicaul, obtuse at the base, narrowing gradually to an apical, coiled tendril (sometimes lacking tendrils in erect forms); basal leaves lacking a lamina or tendril, ensheathing the stem. *Pedicels* solitary, axillary in the axils of vegetative leaves, not articulated, cernuous. *Perianth* segments connate at the base, many-veined, subequal, reflexed or rarely spreading with a longitudinal papillose furrow in the basal  $\pm$  third of the adaxial surface. *Filaments* filiform, attached to the receptacle; anthers dorsifixed, linear-oblong, extrorse. *Ovary* superior, sessile, oblong-ovoid to oblong-obovoid, 3-celled, 1 cell slightly shorter than the other 2; ovules axile, numerous; style filiform with 3 stigmatic branches, reflexed or spreading from the attachment to the ovary. *Capsule* coriaceous, septicidal; seeds globose; perianth persistent but withering as the capsule enlarges.

Distr. Widespread in tropical and southern Africa, Madagascar, India, Burma and SE. Asia, as far as *West Malesia*.

Ecol. Usually climbing in bushes, in habitats ranging from savanna to forest.  
Note. Stated by FIELD (1971, 1972) to be monotypic. In Malesia only a single indigenous species has ever been recognized, although other species have been described elsewhere.

**1. *Gloriosa superba*** LINNÉ, Sp. Pl. (1753) 305; NUTT. Pl. (1927) 436; BACK. Onkr. Suiker. (1928) 189, Atlas (1933) t. 201; GAGNEP. Fl. Gén. I.-C. 6 (1934) 807; H. PERRIER, Fl. Madag. fam. 40 (1938) 135; SILVA, Ceyl. J. Sc. sect. A, 12 (1945) 155; ANN. R. Bot. Gard. Perad. 9 (1925) 243; HEYNE, SANTAPAU, J. Bomb. Nat. Hist. Soc. 46 (1946) 202;



Fig. 1. *Gloriosa superba* L. Botanic Garden Singapore, Febr. 1952 (Photogr. M. R. HENDERSON).



HEND. Mal. Gard. Pl. 4 (1951) 10; Mal. Wild Flow. Monoc. (1954) 178, f. 104; HOLT. MAHA Mag. 15 (1958) 75 (hybrids); BACK. & BAKH. f. Fl. Java 3 (1968) 85; HUTCH. & DALZ. Fl. W. Trop. Afr. ed. 2, 3 (1968) 106; FIELD, Kew Bull. 25 (1971) 243. — *Methonica superba* (L.) CRANTZ, Inst. rei herb. 1 (1766) 474; ZOLL. Syst. Verz. 1 (1854) 66; Nat. Tijds. N. I. 14 (1857) 149; MIQ. Fl. Ind. Bat. 3 (1859) 550. — *G. virescens* LINDL. Bot. Mag. (1825) t. 2539. — Fig. 1, 2.

Stems usually climbing to c. 2 m (rarely to 6 m), less often erect; green. *Leaves* (including the tendril) 8–17½(–25) by (1¼–)1½–4(–4½) cm; tendril usually less than 1 cm long. Pedicels 4½–19 cm. *Perianth* segments narrowly elliptic, with undulate or crisped margins, 5–7(–9) by ¾–1½(–3) cm broad, yellow or red, often (perhaps always in Asia) yellow or green towards the base at first but becoming red throughout later. *Filaments* spreading, 2½–5 cm long; anthers 7–10 mm long. *Ovary* 8–15 mm long; style including the filiform, 3–7(–12) mm long style branches 3½–5½ cm long. *Capsule* 4–10 by c. 1½–2 cm. *Seeds* vivid-red or orange-red, with a fleshy testa, c. 5 mm Ø, tardily falling.

Distr. Tropical and southern Africa, Madagascar, India to Indo-China; in *Malesia*: Java (also Madura and Kangean Is.), S. Celebes, and all Lesser Sunda Is.

Ecol. Brushwood, hedges, teak-forest, only in regions subject to a strong dry season, from near the beach and dunes up to c. 300 m altitude (very rarely 600 m), locally common. It is not native in Sumatra and Borneo, and probably not in continental Malaya. This disjunction in its range between continental SE. Asia and Central South Malesia is clearly caused by its drought preferring ecology. *Fl. fr.* Jan.–Dec.

Uses. Commonly grown as a garden ornamental. The tuber is said to be poisonous (through colchicin), but only slightly so as was tested by BOORSMA (BACKER, 1914; HEYNE, 1927). Fig. 2.

Vern. *Klimlelie*, D, *flame lily*, *superb lily*, E; Java: *kembang djonggrang*, *k. kuku matjan*, *k. sung-*

*sang*, M, *dongkèl sungsang*, *mandalika*, *pa(n)tjing towo*, J, *katongkat*, S, *mand(h)alika*, Md, Balin.; Lesser Sunda Is.: *enatba*, *sikal*, Dawan lang., Timor.

Note. In sterile state easily distinguished from another climbing monocot with coiled apical leaf-tendrils, *Flagellaria indica* L., by absence of a leaf-sheath.



Fig. 2. *Gloriosa superba* L. Old rhizome with scar, the apex with a new tuber emitting roots and a vertical shoot. The two triangular elongations of the new tuber will grow later into new rhizomes; × ½. Botanic Garden, Bandung, 1952. Dug up by L. VAN DER PIJL.

## 2. TRICYRTIS

WALL. Tent. Fl. Nap. (1826) 61, t. 46; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 269; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 608, *nom. gen. cons.* — *Compsoa* D. DON, Prod. Fl. Nep. (1825) 50. — Fig. 3.

Erect puberulous or glabrescent herbs. *Rhizome* short, creeping. Aerial stem annual, simple or branched. *Leaves* cauline, alternate, flat, with several veins and a strong midrib, sessile, entire, lanceolate to ovate, with a sheathing base. *Inflorescence* terminal, racemose, simple or branched, or flowers in the axil of vegetative leaves. *Pedicels* solitary, not articulated. *Perianth* segments free or very shortly united, equal or subequal but the outer three saccate at the base, erect to spreading.



Fig. 3. *Tricyrtis imeldae* GUTIERREZ. a. Habit,  $\times 1/4$ , b. flower, nat. size, c. outer perianth segment, d. inner perianth segment, e. gynoecium, all  $\times 1 1/2$ , f. fruit, nat. size, g. seed,  $\times 12$  (Redrawn from GUTIERREZ, Philip. J. Sc. 103, 1974, 3, fig. 1).



*Filaments* flattened, more or less connivent, free of the perianth; anthers dorsifixed, versatile, oblong, extrorse. *Ovary* superior, sessile, oblong, 3-celled, 3-angled; ovules axile, numerous; style columnar, with 3 spreading or recurved bifid branches. *Capsule* septicidal. Seeds oblong or ovoid.

Distr. Possibly *c.* 20 *spp.*, largely in Japan, also in Manchuria, Korea, throughout China to the Himalayas, Taiwan, and North Malesia: Philippines.

Notes. HUTCHINSON placed this genus in the tribe *Tricyrtideae* possibly with a South African genus *Sandersonia* as the only other member. KRAUSE placed it in the *Tricyrteae* with the closely related, possibly congeneric, *Brachycyrtis*. The genus appears to be taxonomically rather isolated, but probably closest to *Gloriosa* of the Malesian genera.

A thorough revision of the species is badly needed.

**1. *Tricyrtis imeldae* GUTIERREZ, Philip. J. Sc. 103 (1974) 171, f. 1. — Fig. 3.**

Stems erect to 70 cm high, unbranched, puberulous at first. *Leaves* thick and fleshy when fresh but becoming membranous when dried, acute, the lower narrowly elliptic-lanceolate, with cuneate base, the upper broadly lanceolate to elliptic, with cordate base, (6–)12–16 by (3–)4–5 cm, glabrous except for the main veins beneath. *Inflorescence* a terminal bifurcate raceme *c.* 18–20 cm, puberulous; pedicels 3–5 mm, puberulous. *Flowers* greenish-white with purple spots inside, to over 3 cm long, infundibuliform, glabrous, segments linear-oblong to oblong spatulate. *Filaments* 16–18 mm long; anthers 3 mm long, yellowish-brown. *Ovary* 10 mm long; style 8 mm, its branches 8 mm long, purple,

spreading, tuberculate on the inner surface. *Fruit* *c.* 25–30 by 4–6 mm. *Seeds* flat, oblong, *c.* 2 mm long.

Distr. *Malesia*: S. Philippines (Mindanao: Tasaday, Cotabato), reported to be rather rare; only known from the type.

Ecol. Primary forest, along stream at *c.* 1300 m. Fl. Aug.

Vern. Philippines: *amutmagiso*, Tasaday.

Notes. I have only seen the type and have not been able to add to the description by GUTIERREZ.

He compared the species with the Formosan *T. stolonifera*, from which it chiefly differs in the shape and colouring of the perianth segments. Close study of more material and variability is needed to check the specific difference.

### 3. IPHIGENIA

KUNTH, En. Pl. 4 (1843) 213; BAKER, J. Linn. Soc. Bot. 17 (1880) 450; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 272; H. PERRIER, Fl. Madag. fam. 40 (1938) 136; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 612; OBERMEYER, *Kirkia* 1 (1961) 84, *nom. gen. cons.* — *Aphoma* RAF. Fl. Tellur. 2 (1836) 31, *nom. rejic.* — **Fig. 4.**

Erect, glabrous herbs. Corm enclosed in dry leaf bases; roots fibrous. Aerial stem annual, unbranched. *Leaves* cauline, with tubular, ensheathing bases; the lowest 1 or 2 often with a poorly developed lamina; the others decreasing in size from the lowest towards the uppermost, the uppermost often approaching the lowest bracts in size, *c.* 4–7; lamina flat, glabrous, sessile, entire, linear to lanceolate, acute. *Flowers* solitary, in a few-flowered cluster or in a raceme terminating the stem. *Pedicels* solitary, erect-spreading, not articulated. *Perianth* segments free,  $\pm$  equal, spreading or reflexed, few-veined. *Filaments* flattened, attached to the receptacle; anthers dorsifixed or basifixed, extrorse. *Ovary* superior, sessile, ovoid, oblong or obovoid, 3-celled; ovules  $\infty$ , axile; styles 3, (free or) fused at the base only. *Capsule* globose, cylindrical or ellipsoid, loculicidal. Seeds globose or angular; perianth deciduous.

Distr. Southern and tropical Africa (5 *spp.*), Madagascar (2 *spp.*), SE. Asia (4 *spp.*), of which one species extends through Malesia to Australia, and New Zealand.

Ecol. Usually in open grassland, sometimes in damp areas.

1. *Iphigenia indica* (L.) A. GRAY *ex* KUNTH, En. Pl. 4 (1843) 213; MIQ. Fl. Ind. Bat. 3 (1859) 552; BTH. Fl. Austr. 7 (1878) 31; BAKER, J. Linn. Soc. Bot. 17 (1880) 450; F.v.M. Descr. Not. 6 (1885) 18; HOOK. f. Fl. Br. Ind. 6 (1892) 357; BAILEY, Queensl. Fl. 5 (1902) 1641; LAUT. Bot. Jahrb. 50 (1913) 292; MERR. En. Philip. 1 (1922) 202; BACK. Handb. Fl. Java 3 (1924) 51; KRAUSE, Bot. Jahrb. 59 (1925) 548; BACK. & BAKH. f. Fl. Java 3 (1968) 85. — *Melanthium indicum* LINNÉ, Mant. 2 (1771) 226. — *Anguillaria indica* (L.) R. BR. Prod. (1810) 273; WALL. Pl. As. Rar. 3 (1832) 37, t. 259. — Fig. 4.

Corm usually  $\pm$  globose, 5–10 mm  $\varnothing$ . *Leaves* linear-lanceolate, often with a single conspicuous vein and 2–8 rather inconspicuous ones, the longest c. 10–40 cm long, up to 6 mm wide, the shortest often less than a quarter of the length of the longest; lower leaf bases sometimes pubescent, glandular pubescent or scabrid, especially on the veins. Flowers 1–3. *Pedicels* erect or erect-spreading 5–40 mm. *Perianth* segments  $\pm$  spreading, narrowly oblanceolate (inner whorl sometimes narrower than the outer), 5–9 by up to 2 mm, dark-brown or red-brown, reddish, purplish or white, described by BACKER (1924) as having a green keel and apex. *Filaments* linear, up to half as long as the perianth, green basally, brown distally; anthers dorsifixed, c.  $\frac{1}{2}$ –1 mm long. *Ovary* obovoid to ovoid, c.  $1\frac{1}{2}$ –2 $\frac{1}{2}$  mm long; styles recurved, c. 1 mm. *Capsule* c. 10–20 mm long; seeds c.  $1\frac{1}{2}$  mm  $\varnothing$ .

Distr. Ceylon, India to Thailand, S. China, in *Malesia* rare: N. Sumatra (Lake Toba), Java (Indramayu in W, Surabaya and Madura I. in E), the Lesser Sunda Is. (Timor and Wetar), Philippines (Luzon, Mindanao), New Guinea, and Australia (W. Australia, Northern Territory and Queensland).

Ecol. A rather uncommon species of open, often poor grassland, always under seasonal climatic conditions. In Java only in the lowland but elsewhere also in the hills, in N. Sumatra at c. 1000 m. Flowers are reported by BACKER (1924) to occur for a short period during the rainy period (Dec.–Jan.) in Java, with fruit ripening in March, after which the aerial parts soon wither and disappear. Elsewhere other flowering dates have been noted from July to August, N of the equator, where seasons are reversed.



Fig. 4. *Iphigenia indica* (L.) A. GRAY *ex* KUNTH. a. Habit, nat. size, b. flower, c. fruit, both  $\times 2$  (Partly after WALLICH, Pl. As. Rar. 3, 1832, t. 259).

#### 4. PETROSAVIA

BECC. Nuov. Giorn. Bot. Ital. 3 (1871) 7, t. 1; RIDL. J. Str. Br. R. As. Soc. n. 24 (1891) 170; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 256; HUTCH. Kew Bull. (1933) 156; STEEN. Trop. Natuur 23 (1934) 52; NAKAI, J. Jap. Bot. 17 (1941) 191; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 546. — *Protolirion* RIDL. Ann. Bot. 9 (1895) 45; GROOM, *l.c.*; RIDL. Fl. Mal. Pen. 4 (1924) 322; KRAUSE in E. & P. Nat.



Pfl. Fam. ed. 2, 15a (1930) 257, f. 87; NAKAI, J. Jap. Bot. 17 (1941) 191. — *Miyoshia* MAKINO, Bot. Mag. Tokyo 17 (1903) 144; NAKAI, J. Jap. Bot. 17 (1941) 191. — **Fig. 5.**

Erect, glabrous, saprophytic, pale yellow or cream coloured, herbs lacking chlorophyll. *Rhizome* slender, simply or sparsely branched, bearing alternate, often imbricate scale-leaves. Aerial stems 1 or less often up to 3 or more, unbranched. *Leaves* scale-like, spiral, sessile, entire; the base usually partly embracing the stem, rather well-spaced. *Raceme* terminal, usually simple, sometimes corymbose. *Pedicels* solitary, with 0–2 alternate bracteoles near the centre or in the lower half (often concealed by the subtending bract), not articulated, in the axils of bracts resembling the scale-leaves. *Perianth* segments erect-spreading, with a single vein, cream-coloured to yellow; the outer 3 distinctly inserted outside the inner 3, even in the open flower, and narrower and shorter. *Filaments* sublinear attached to the receptacle or to the base of the perianth segments; anthers basifixed, introrse or dehiscent laterally. *Ovary* superior or semi-inferior; the 3 carpels free above the receptacle; styles 1 on each carpel, capitate or subcapitate; ovules attached to ventral surface, numerous, in 3–c. 6 rows. *Fruit* dry, dehiscent along the ventral suture; the 3 segments spreading. *Seeds* numerous, ovoid, with longitudinal ridges; perianth persistent.

Distr. Japan (Prov. Mino), China (Kwangsi and Taiwan), Indo-China (Tonkin), in *Malesia*: Malaya, N. half of Sumatra, Borneo (Sabah, Sarawak), and Central Celebes.

In addition to the two species from Malesia and Japan, a third has been described from Tonkin and S. China (Kwangsi): *Petrosavia sinii* (KRAUSE) KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 257; GAGNEP. Fl. Gén. I.-C. 6 (1934) 802, f. 78 (10–13); (Anonymous) Icon. Corm. Sin. 5 (1976) 424, f. 7677. — *Protolirion sinii* KRAUSE, Notizbl. Berl.-Dahl. 10 (1929) 806.

It is highly probable that this is a synonym of *P. sakuraii* and would thus neatly fill a gap in the range of that species.

Ecol. Saprophytes on the forest flora, in Malesia in the hills at 1000–2000 m.

Notes. This genus has been placed in the *Liliaceae* (*Liliales*) by KRAUSE (1930), the *Petrosaviaceae* (*Alismatales*) by HUTCHINSON (1959) and the *Miyoshiaceae* (*Miyoshiales*) by NAKAI (1941). Both in being saprophytic and in having 2- or multi-seriate ovules it is anomalous in either the *Liliales* (*sensu* HUTCHINSON) or the *Alismatales*. ERDTMAN (Pollen Morph. & Pl. Taxon., Angiosp., 1952, 235) described the pollen as 1-sulcoidate which is unknown in the *Scheuchzeriaceae* or *Alismataceae* (*Alismatales*) but present, although uncommon, in the *Liliaceae*. M. Y. STANT (Bot. J. Linn. Soc. 63, 1970, Suppl. 1, 147) investigated the anatomy of *P. stellaris* and found it to be indistinguishable from that in the (saprophytic) *Triuridaceae* (*Triuridales*). Although here retained in the *Liliaceae* it is admitted that further investigation may show it to be better placed elsewhere.

The roots lack root-hairs but contain an endotrophic mycorrhiza (GROOM, 1895).

#### KEY TO THE SPECIES

1. Inflorescence corymbose; pedicels all arising close to the peduncle apex, usually 10 mm or more long **1. *P. stellaris***
1. Inflorescence racemose; pedicels spaced along the peduncle, usually 8 mm or less long **2. *P. sakuraii***

**1. *Petrosavia stellaris* BECC.** Nuov. Giorn. Bot. Ital. 3 (1871) 8, t. 1; RIDL. J. Str. Br. R. As. Soc. n. 24 (1891) 171; GROOM, Ann. Bot. 6 (1892) 380; HUTCH. Kew Bull. (1933) 156; STEEN. Trop. Natuur 23 (1934) 52, f. 12 right; NAKAI, J. Jap. Bot. 17 (1941) 191; HEND. Mal. Wild Flow. Monoc. (1954) 178, f. 103; STANT, Bot. J. Linn. Soc. 63 (1970) Suppl. 1, 147, anat. — *Protolirion paradoxum* RIDL. Ann. Bot. 9 (1895) 56; GROOM,

l.c. 45, pl. 3; RIDL. Mat. Fl. Mal. Pen. Monoc. 2 (1907) 87; Fl. Mal. Pen. 4 (1924) 322, f. 195; NAKAI, J. Jap. Bot. 17 (1941) 191. — **Fig. 5a.**

Aerial stems (4–)6–11 cm high. Scale-leaves of rhizome ovate, c. 2–5 mm long, their base amplexicaul, often forming a closed sheath. Scale-leaves of aerial stem narrowing gradually to the acute apex, 3–6 mm long, their base partly embracing the stem. *Raceme* simple, corymbose, with 1–12 flowers.

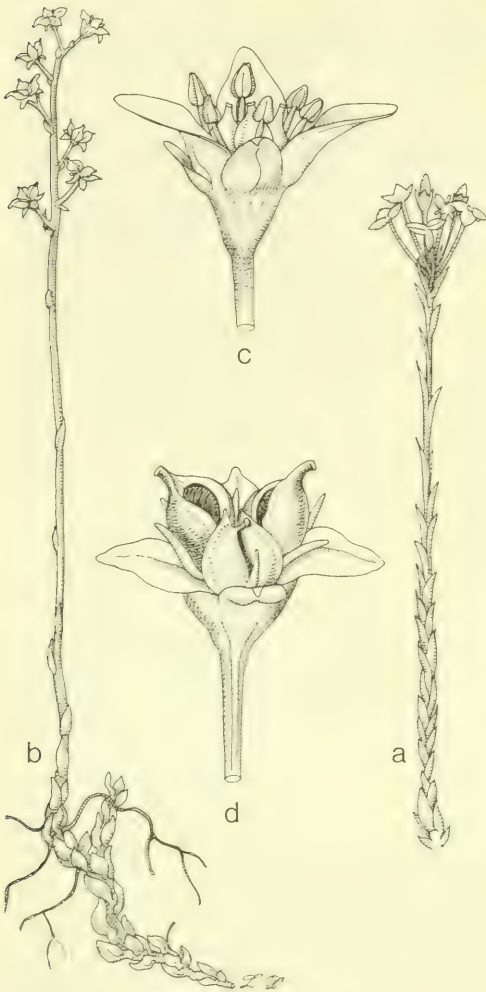


Fig. 5. *Petrosavia stellaris* BECC. a. Habit, nat. size (Redrawn from HUTCHINSON, Fam. Fl. Pl. 2, 1959, fig. 347). — *P. sakurarii* (MAKINO) J. J. SMITH ex STEEN. b. Habit, nat. size, c. flower, d. flower in fruit, both  $\times 10$  (Redrawn from MAKINO, Bot. Mag. Tokyo 17, 1903, pl. 5).

*Pedicels* all arising close to the apex of the stem, usually less than 1 mm apart, (5-)10-16(-20) mm. Outer *perianth* segments ovate to lanceolate, acute, 1-2 by c.  $\frac{1}{2}$  mm. Inner perianth segments ovate,  $\pm$  acute,  $2\frac{1}{4}$ - $3\frac{1}{2}$  by  $1\frac{1}{2}$ -2 mm. *Filaments* c. 2 mm; anthers less than  $\frac{1}{2}$  mm long. *Ovary*  $\pm$  superior; styles up to 1 mm long. *Capsule* segments 3-4 mm long. Seeds c.  $\frac{3}{4}$  mm long.

Distr. *Malesia*: Sumatra (West Coast Res.), Malay Peninsula, Borneo (Sarawak, Sabah), and Central Celebes (Masamba: Mt Kambuno).

Ecol. Recorded by RIDLEY (1924) "in dry woods at the foot of *Dacrydium*" and by EYMA (EYMA 1305, L) from "forest, rather dark, without undergrowth". Other records refer to sandy forest, mossy forest and among bamboos. Recorded between 100 and 1000 m. *Fl.* usually Febr.-Sept.

2. *Petrosavia sakurarii* (MAKINO) J. J. SMITH ex STEEN. Trop. Natuur 23 (1934) 52. — *Miyoshia sakurarii* MAKINO, Bot. Mag. Tokyo 17 (1903) 144, pl. 5; l.c. 208. — *Protolirion miyoshia-sakurarii* MAKINO, Bot. Mag. Tokyo 17 (1903) 208, *nomen err. et provis., illeg.*; PILG. in E. & P. Nat. Pfl. Fam. Nachtr. 3 (1908) 44, f. 8, *ditto*. — *Protolirion sakurarii* (MAKINO) DANDY, J. Bot. 69 (1931) 53. — Fig. 5b-d.

Aerial stems (5-)10-21(-27) cm high. Scale-leaves of rhizome ovate, c. 2-5 mm long, their base amplexicaul, often forming a closed sheath. Scale-leaves of aerial stem narrowing gradually to the acute apex, 4-6 mm long, their base partly embracing the stem or rarely completely amplexicaul. *Raceme* simple or with few-flowered branches towards the base, elongate, with (3-)6-25(-30) flowers. *Pedicels* of mature flowers usually at least 2 mm apart, 3-8 mm. Outer *perianth* segments ovate to lanceolate, acute,  $1\frac{1}{2}$ -2 by  $\frac{1}{2}$ -1 mm. Inner perianth segments ovate,  $\pm$  acute, 2-3 by  $1\frac{1}{4}$ - $1\frac{3}{4}$  mm. *Filaments* c. 2 mm; anthers less than  $\frac{1}{2}$  mm long. *Ovary* superior to semi-inferior; styles up to 1 mm. *Capsule* segments 2-3 mm long. Seeds c.  $\frac{3}{4}$  mm long.

Distr. Japan (Prov. Mino), Formosa, Burma and *Malesia*: northern half of Sumatra (Gajolands; Westcoast Res.).

Ecol. Along forest paths and on flat forest ridges, 1000-2000 m. *Fl.* March-July, Nov.

## 5. SCHELHAMMERA

R. BR. Prod. (1810) 273; BTH. Fl. Austr. 7 (1878) 31; BAKER, J. Linn. Soc. Bot. 17 (1879) 466; BAILEY, Queensl. Fl. 5 (1902) 1642; MAIDEN & BETCHE, Cens. N.S.W. Pl. (1916) 40, as *Schellhammera*; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 266; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 606, as *Schellhammeria*; *nom. gen. cons.* — Fig. 6.



Erect, mainly glabrous herbs. *Rhizome* rather thick; roots fibrous. Aerial stems annual, simple or with 1–3 branches, often slightly swollen at the nodes; branches erect. *Leaves* cauline, alternate, flat, with many veins and usually a strong midrib, sessile or shortly petioled, lanceolate to ovate, often at least partly amplexicaul, obtuse or cuneate at the base, acute at apex. Leaves on rhizome and lower parts of aerial stems and branches scale-like. *Inflorescence* terminal, consisting of a sessile or peduncled umbel or of a single flower. *Pedicels* straight, articulated or not. *Perianth* segments free, equal, spreading to shallowly campanulate, with several usually inconspicuous veins. *Filaments* flattened, tapering from the base, attached to the base of the perianth segments; anthers basifixed, linear-oblong, extrorse. *Ovary* superior, sessile, obovoid, globose or oblong, often fairly deeply 3-lobed, 3-celled; ovules axile, few (c. 4–12) per locule; style filiform, with 3 deeply divided branches. *Capsule* somewhat fleshy.

Distr. Three *spp.* in eastern Australia, one of which also in *East Malesia*: New Guinea.

Ecol. Most records suggest a preference for rain-forest, but also recorded in scrub and on open slopes in the lowland and hills.

1. *Schelhammera multiflora* R. BR. Prod. (1810) 274; F.v.M. Descr. Not. 4 (1876) 73; BTH. Fl. Austr. 7 (1878) 32; LAUT. Bot. Jahrb. 50 (1913) 292; HALL. f. Nova Guinea 8 (1914) 989; KRAUSE, Bot. Jahrb. 59 (1925) 548. — Fig. 6.

Stems 10–40 cm, rarely minutely and sparsely pubescent. *Leaves* 4–8 by 1–3 cm, usually minutely ciliate on the margin and veins towards the base; petiole usually absent, rarely up to 5 mm. Scale-leaves ovate to lanceolate, dry, sessile, amplexicaul, usually 5–10 mm long. *Pedicels* usually 5–30, articulated at base of flower, 1–3 cm. *Perianth* segments obovate, acute, with the sides turned up to form a gutter-shaped structure in which the anthers are partly enclosed, swollen on the abaxial surface at the base,  $4\frac{1}{2}$ –8 by c. 2 mm, white. *Filaments* c. 3 mm; anthers c. 2 mm long, brown or black. *Ovary* obovoid, 6-lobed, c.  $1\frac{1}{2}$  mm long; style 3–4 mm, divided for at least half its length; branches adhering to one another rather firmly at first, later recurving; ovules few (c. 2–4) per locule. Fruit and seeds not seen.

Distr. Australia (Queensland) and *E. Malesia*: S. New Guinea (Merauke area: Okaba; Fly R. area).

Ecol. In lowland grassland on open slopes, subject to a strong or distinct dry season, in Queensland also in open forest, obviously a rare species, below 400 m. *Fl.* March–Sept.

Note. The two further Australian species are *S. undulata*, which has larger solitary flowers, and *S. pedunculata*, which has peduncled umbels.

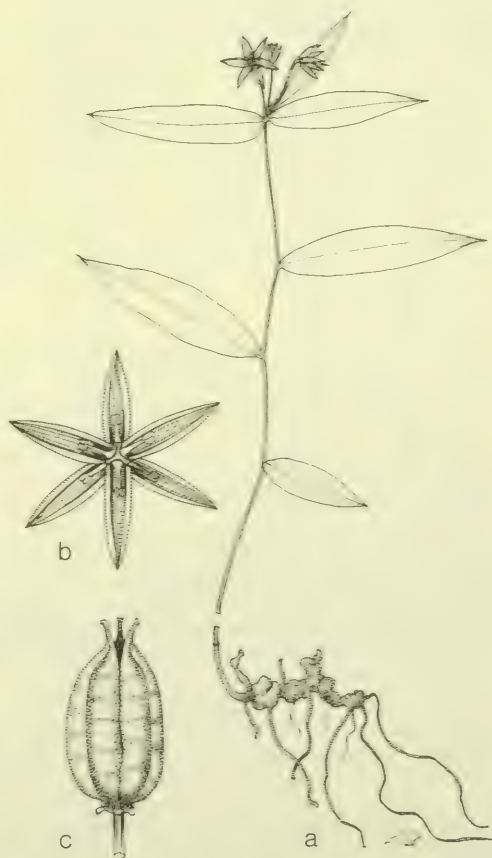


Fig. 6. *Schelhammera multiflora* R. BR. a. Habit,  $\times \frac{1}{2}$ , b. flower, c. capsule, both  $\times 2$ .

## 6. ARTHROPODIUM

R. BR. Prod. (1810) 276; BAKER, J. Linn. Soc. Bot. 15 (1876) 351; BTH. Fl. Austr. 7 (1878) 55; BAILEY, Queensl. Fl. 5 (1902) 1629; EWART, Fl. Vict. (1930) 292; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 286; BLACK, Fl. S. Austr. 1 (1943) 193; PAYENS, Nova Guinea n.s. 8 (1957) 388; SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 207 (1957) 6, map; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 598. — *Dichopogon* KUNTH, En. Pl. 4 (1843) 622; BAKER, J. Linn. Soc. Bot. 15 (1876) 318; BTH. Fl. Austr. 7 (1878) 58; BAILEY, Queensl. Fl. 5 (1902) 1631; EWART, Fl. Vict. (1930) 291; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 285; BLACK, Fl. S. Austr. 1 (1943) 193; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 598. — **Fig. 7.**

Stemless herbs. *Rhizome* very short. Roots fibrous or somewhat fleshy, often producing well-defined, distant tubers. *Leaves* basal, linear to lanceolate, gradually expanding towards the base to form (apparently dry and membranous) open sheaths, sometimes ciliate or with bristles along the margins; veins of the sheaths sometimes persisting on an outer zone of fibres. *Inflorescence* a raceme or panicle. *Pedicels* 1–3(–5)-nate, in the axils of bracts and usually associated with a few smaller bracts also apparently in the axil of the principal bract, articulated usually in the distal half, rather long and filiform. *Perianth* segments usually free, the inner whorl broader, with 3 or less often 5 veins, spreading. *Filaments* linear-filiform, usually attached to the base of the perianth segments; anthers basifixed, oblong to linear, often strongly arcuate, dehiscing laterally or introrsely; papillose or pubescent appendages always present, usually adnate to the filaments and often also to the anthers. *Ovary* superior, sessile, subglobose to ellipsoid, 3-celled; ovules axile, 2–10 in each locule; style filiform, simple, minutely capitate. *Capsule* dehiscing loculicidally; perianth segments adhering, marcescent, not twisting after flowering. Seeds angular.

Distr. Madagascar (1 *sp.*), New Zealand (2 *spp.*), New Caledonia (1 *sp.*), and c. 9 *spp.* in Australia, of which one extends into *Malesia*: New Guinea (South Papua).

Ecol. Usually in open grassland or open woodland, often at rather low altitudes (below 250 m).

Species have been described as having chocolate or vanilla scents.

Notes. PAYENS (1957) made a strong case for combining *Dichopogon* with *Arthropodium*. Nevertheless, authors (e.g. BURBIDGE and GRAY, Fl. A.C.T., 1970) have continued to separate these genera principally on whether the papillose or pubescent staminal appendages are adnate to the filaments (in *Arthropodium*) or to the anthers (in *Dichopogon*). An examination of species represented at Leyden and Adelaide has convinced me that these two genera cannot be separated. A particularly significant form is *A. neo-caledonicum* in which the appendages are attached to both filaments and anthers such that it would be difficult to assign this species to a genus. In most of the material of *Dichopogon* the appendages are also distinctly adnate to the filaments as well as to the anthers. *Dichopogon strictus* and *Arthropodium capillipes*, although placed in separate genera, have almost indistinguishable stamens.

**1. *Arthropodium strictum*** R. BR. Prod. (1810) 276; F.v.M. Descr. Not. 6 (1885) 17; LAUT. Bot. Jahrb. 50 (1913) 292; KRAUSE, *ibid.* 59 (1925) 548; PAYENS, Nova Guinea n.s. 8 (1957) 390; EICHLER, Suppl. Fl. S. Austr. (1965) 83. — *Dichopogon strictus* (R. BR.) BAKER, J. Linn. Soc. Bot. 15 (1876) 319; BTH. Fl. Austr. 7 (1878) 58; BAILEY, Queensl. Fl. 5 (1902) 1631; EWART, Fl. Vict. (1930) 291; GARDNER, En. Pl. Austr. Occ. (1931) 18; BLACK, Fl. S. Austr. 1 (1943) 194. — **Fig. 7.**

Roots bearing distant tubers c. 1–1½ cm long. *Leaves* 3–12, suberect, sublinear but narrowing gradually towards the apex and sometimes also towards the basal sheath where they again become broader, glabrous or minutely ciliate on the margins, 20–45 cm by 3–7 mm; veins of leaves not forming fibrous sheaths at base of plant. Peduncle simple or more often with 1–4 ascending branches, (20–)30–60(–110) cm high. Bracts rarely up to 6 cm long at the base of the lowest branch, but usually



5–15 mm long, ovate to lanceolate, narrowing gradually to the apex, partly scarious. *Pedicels* solitary or less often 2- or 3-nate, erect-spreading, 12–20 mm. *Perianth* segments purple, 9–14 by c. 3–3½ mm. *Filaments* c. 1½–2 mm; anthers 3–5 mm long; appendages less than 1 mm long, free of or only shortly adnate to filaments. *Ovary* globose-ellipsoid, 1½–4 mm long; ovules 8–10 in each locule; style 6–7 mm. *Capsule* subglobose, c. 5 mm Ø, with several seeds; perianth marcescent or rarely persistent.

Distr. Australia (all states but not yet from the Northern Territory) and *Malesia*: SE. New Guinea (Port Moresby area).

Ecol. Open grassland and open woodland at low altitude, subject to a long dry season.

Vern. *Chocolate lily*, E (Australia).

Note. PAYENS (1957) stated that the perianth segments are connate for 1 mm. This was not confirmed by me for material he had examined.

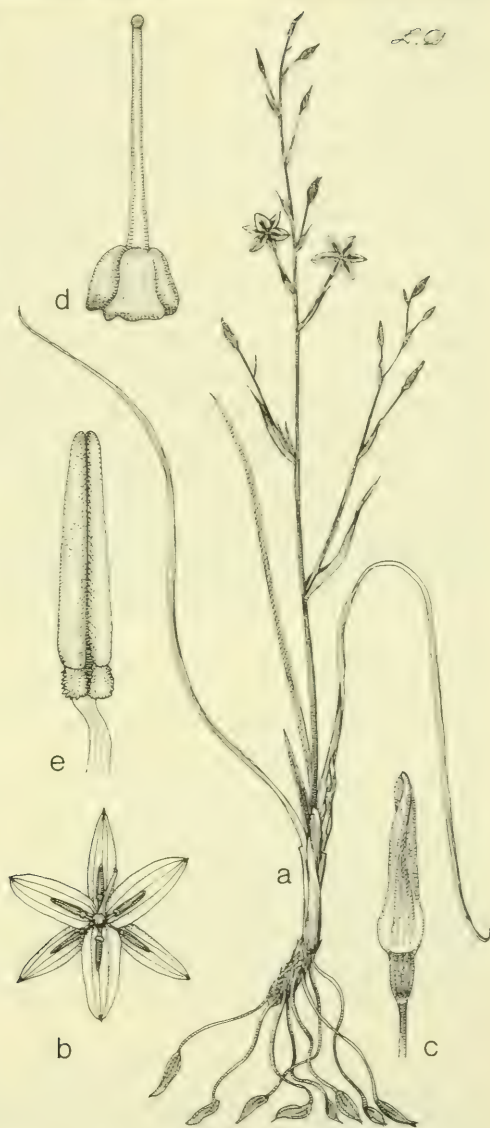


Fig. 7. *Arthropodium strictum* R. BR. a. Habit,  $\times \frac{1}{2}$ , b. flower,  $\times 2$ , c. withered flower,  $\times 3$ , d. gynoecium,  $\times 7$ , e. anther,  $\times 10$  (C. R. ALCOCK 2875, S. Australia).

## 7. CAESIA

R. BR. Prod. (1810) 277; BAKER, J. Linn. Soc. Bot. 15 (1876) 357; BTH. Fl. Austr. 7 (1878) 46; BAKER, Fl. Cap. 6 (1897) 400; BAILEY, Queensl. Fl. 5 (1902) 1632; EWART, Fl. Vict. (1930) 289; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 288; BLACK, Fl. S. Austr. 1 (1943) 192; PHILLIPS, Gen. S. Afr. Fl. Pl. ed. 2 (1951)

1002; PAYENS, Nova Guinea n.s. 8 (1957) 383; SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 207 (1957) 6, map; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 596; OBERMEYER, Bothalia 11 (1973) 122. — **Fig. 8.**

Stemless herbs. *Rhizome* very short. Roots fibrous, fleshy or tuberous. *Leaves* basal, subulate to linear, expanded at the base to form a sheath. *Inflorescence* a raceme or more often a panicle. *Pedicels* 1–3-nate, in the axils of bracts and usually associated with a few smaller bracts also apparently in the axil of the principal bract, articulated usually in the distal half. *Perianth* segments free or shortly connate, subequal, 3-veined, spreading. *Filaments* filiform or linear, glabrous, attached to the receptacle or to the base of the perianth segments; anthers basifixed, oblong, dehiscent introrsely. *Ovary* superior, sessile, globose or subglobose, 3-celled; ovules axile, 2 in each locule; style filiform, simple, minutely capitate. *Capsule* dehiscent loculicidally; perianth segments adhering, marcescent, twisting spirally after flowering. Seeds angular or globose, usually solitary in each locule.

Distr. Madagascar (1 *sp.*), South Africa (2 *spp.*; Cape Province) and Australia (7–9 *spp.*), of which one species also occurs in *Malesia*: S. Papua New Guinea (W. Distr.: Wassi Kussa area).

Ecol. Usually in the open, but also in savanna.

Note. Generically this group is regarded as well-defined by the spirally-twisting perianth and 2-ovuled locules. The South African monotypic genus *Nanolirion* BTH. (1883) was formerly distinguished by having a 1–3-flowered inflorescence (PHILLIPS, 1951), but OBERMEYER (1973) placed it under *Caesia*.

**1. *Caesia setifera* BAKER**, J. Linn. Soc. Bot. 15 (1876) 359; BTH. Fl. Austr. 7 (1878) 47; EWART & DAVIES, Fl. North. Terr. (1917) 71; PAYENS, Nova Guinea n.s. 8 (1957) 384, f. 1. — **Fig. 8.**

Roots bearing distant spindle-shaped tubers *c.* 1–1½ cm long. *Leaves* 2–4, suberect, filiform, glabrous, *c.* 10–25 cm long, *c.* 1 mm broad; veins of leaves forming fibrous sheaths at base of plant. Peduncle thin and wiry, usually with 1 or 2 ascending branches, (17–)25–45 cm high. Bracts bearing branches or pedicels in their axils, rarely up to 5 mm long, ovate to lanceolate, partly scarious. *Pedicels* 1–6-nate, usually erect-spreading, (3–)5–10 mm. *Perianth* segments blue, linear-oblong, 6–8 by 1–1½ mm. *Filaments* 3–4 mm (the outer up to 1 mm

longer than the inner); anthers yellow, *c.* ½–¾ mm long. *Ovary* *c.* ¾–1 mm long; style 4–5 mm. *Capsule* subglobose, deeply 3-lobed, *c.* 3 mm Ø.

Distr. Australia (Queensland and Northern Territory); in *Malesia*: S. Papua New Guinea: Western District, Wassi Kussa area: Morehead, Weam, Arufi, Tarara.

Ecol. In the Wassi Kussa area scattered on open, grass-sedge plains on thin sand over clay, in maintained savanna grassland, in savanna with *Melaleuca* and *Acacia*, on wet flats in savanna forest, on sour grey soils, at very low altitudes subject to a long dry season. *Fl.* July–Aug., Dec.–Jan.

A field note recorded that usually one flower is opening in sequence.

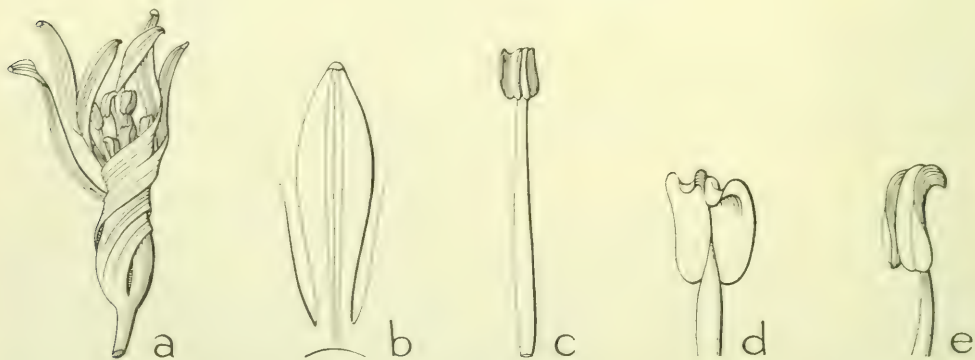


Fig. 8. *Caesia setifera* BAKER. a. Flower after anthesis, with persistent twisted perianth, b. sepal inside, c. stamen, all  $\times 6$ , d–e. anther, dorsal and lateral,  $\times 15$  (a BRASS 8599, b–e BRASS 8560).



## 8. CHLOROPHYTUM

KER-GAWL. Bot. Mag. 27 (1808) t. 1071; BAKER, J. Linn. Soc. Bot. 15 (1876) 321; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 284; POELLN. Ber. Deut. Bot. Ges. 61 (1943) 126; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 598; DRESS, *Baileya* 9 (1961) 29; OBERMEYER, *Bothalia* 7 (1962) 690; BACK. & BAKH. f. Fl. Java 3 (1968) 86; CHAROENPHOL, Thai For. Bull. 7 (1973) 67; PANIGRAHI, Kew Bull. 30 (1975) 563; MARAIS & REILLY, Kew Bull. 32 (1978) 653.

Perennial stemless herbs. *Rhizome* horizontal, often very short. Roots fibrous, or fleshy or tuberous. *Leaves* basal, usually rosulate, linear to lanceolate, often with a fimbriate margin, expanding towards the base to form a sheath. *Inflorescence* a raceme or a panicle. *Pedicels* 1–6-nate, in the axils of bracts and associated with a few small bracts also apparently in the axil of the principal bract, articulated usually near or below the middle. *Perianth* segments free, subequal, with 3 or 5 veins, most frequently spreading or reflexed. *Filaments* filiform, glabrous or papillate, attached to the receptacle; anthers basifixed, linear-oblong, introrse. *Ovary* superior, sessile or shortly stipitate, globose or obovoid, 3-lobed, 3-celled; ovules axile, 2 or more in each locule; style filiform, simple, minutely capitate. *Capsule* dehiscent loculicidally; perianth segments adhering, marcescent, not twisting after flowering. Seeds flat, suborbicular.

Distr. Especially in Africa (mainly southern and tropical), Madagascar and Asia (especially India) to Australia (2 spp.); in *West Malesia* two non-endemic species.

The total number of species is estimated by KRAUSE (1930) at c. 100 and by OBERMEYER (1962) at nearly 300.

Ecol. Species of *Chlorophytum* occur in a wide range of habitats from coastal to montane regions. They grow in many soil types and in rock crevices, and in open grassland and dense forest.

Notes. OBERMEYER (1962) recorded that in species with fascicled flowers plants do occasionally occur in which the flowers are borne spirally on a distinct but very short lateral branch of the inflorescence. This supports the theory that fascicled flowers and their associated bracts represent an abbreviated lateral shoot.

She also discussed the difficulty encountered in separating *Chlorophytum* from *Anthericum* L. (1753). She was only able to find a single character on which these genera could always be separated: the seeds of *Chlorophytum* are flat, but of *Anthericum* angular and smaller. Several other characters were found to be generally, but not universally, of value in separating them.

## KEY TO THE SPECIES

1. Perianth segments 3–5 mm long. Anthers less than 1 mm long. Leaves usually 4–8 mm broad

1. *C. laxum*

1. Perianth segments 7–12 mm long. Anthers 4–5 mm long. Leaves usually 10–50 mm broad

2. *C. malayense*

1. *Chlorophytum laxum* R. BR. Prod. (1810) 277; HOOK. f. Fl. Br. Ind. 6 (1892) 336; BACK. Handb. Fl. Java 3 (1924) 52, incl. f. *javanicum* (HASSK.) BACK.; GAGNEP. Fl. Gén. I.-C. 6 (1934) 804; BACK. & BAKH. f. Fl. Java 3 (1968) 86; HUTCH. & DALZ. Fl. W. Trop. Afr. ed. 2, 3 (1968) 100. — *C. laxiflorum* BAKER, J. Linn. Soc. Bot. 15 (1876) 328, nom. illeg. — *Nolina javanica* HASSK. Tijds. Nat. Gesch. Phys. 10 (1843) 120; MIQ. Fl. Ind. Bat. 3 (1859) 554.

Roots often bearing tubers c. 1–5 cm long (absent in material I have seen from Malesia and stated by BACKER & BAKHUIZEN VAN DEN BRINK f. to be absent in Javanese plants). *Leaves* 4–12 or rarely more, linear to lanceolate, usually channelled especially towards the base, with a rather prominent midrib; suberect, glabrous, 10–30(–50) cm by 4–8(–12) mm, rarely forming fibrous sheaths round the base of the plants; the outer arcuate and recurved; the inner often straight. Peduncle straight

or flexuous, unbranched or rarely with a single branch, (5-)15-35(-60) cm. Lower bracts 3-12 mm long, usually lanceolate-acuminate, partly scarious. *Pedicels* solitary or, less often, 2-nate, often erect-spreading but recurring in fruit, 3-12 mm. *Perianth* segments white or 'greenish white', linear-oblong, 3-5 by c. 1 mm. *Filaments* (1½)-2-3 (-4) mm long (the outer often longer than the inner); anthers up to ½ mm long. *Ovary* c. 1 mm long, obovoid or globose; style less than 2 mm; ovules 2 per locule. *Capsule* usually obovoid, less often globose or depressed-globose, 3-lobed, 5-10 mm long.

Distr. Tropical Africa (e.g. Senegal, Liberia, Ghana, Nigeria, Zambia, Ethiopia), S. Asia (e.g. India, Indo-China, Thailand), China (incl. Hainan); in *Malesia*: N. Sumatra (Eastcoast Res.), Malay Peninsula, W. and Central Java, and SE. Borneo (Bandjermasin), extending to N. Australia (Queensland and Northern Territory).

Ecol. Recorded from a variety of localities including rock crevices and in sandy soils, but usually a species of shady places (including bamboo forest, deciduous forest and a coconut grove), usually below 1000 m. *Fl.* Jan.-Dec.

Notes. BACKER (1924) and BACKER & BAKHUIZEN VAN DEN BRINK f. (1968) treat the Javanese plants as belonging to *forma javanicum* (HASSK.) BACK. They give no reason for this decision and in the absence of a monograph of this species I would prefer not to uphold this form.

*Extra-Malesian* synonyms are omitted from the references.

2. *Chlorophytum malayense* RIDL. *Fl. Mal. Pen.* 5 (1925) 341; PANIGRAHI, *Kew Bull.* 30 (1975) 565. — *C. orchidastrum* (non LINDL. *Bot. Reg.* 10 (1824) t. 813) RIDL. *Mat. Fl. Mal. Pen. Monoc.* 2 (1907) 92; *Fl. Mal. Pen.* 4 (1924) 327; GAGNEP. *Fl. Gén. I.-C.* 6 (1934) 806; CHAROENPHOL, *Thai For. Bull.* 7 (1973) 67.

Roots sometimes bearing tubers 3-4 mm or more long. *Leaves* 3-10, sublinear or indistinctly petioled and with a lanceolate lamina, channelled towards the base, with a rather prominent midrib, suberect, glabrous, (10-)25-60 by (½)-1-5(-10) cm, never forming fibrous sheaths round the base of the plant. Peduncle glabrous or less often glandular pubescent, with 0-~ branches (30-)40-50(?-90) cm high. Lower bracts up to 9 cm long, usually narrowly lanceolate-acuminate, usually partly scarious; the lowest usually sterile. *Pedicels* usually 2-3-nate,

less often solitary, erect-spreading, not recurring in fruit, 3-10 mm. *Perianth* segments white, elliptic to linear-oblong, 7-12 by 2-3 mm. *Filaments* occasionally minutely pubescent, 4-5 mm (not always similar in length but neither whorl regularly longer than the other); anthers 4-5 mm long. *Ovary* c. 1½-2 mm long, obovoid or globose; style 3-4(-8, GAGNEPAIN, 1934) mm; ovules 4-6 per locule. *Capsule* globose, strongly emarginate and very deeply 3-lobed, c. 5-8 mm Ø.

Distr. Indo-China, Thailand and *Malesia*: Malay Peninsula (Perak and Perlis).

Ecol. This is usually a forest (including bamboo, oak, pine) species, often associated with limestone, 50-1500 m. *Fl.* Jan.-Dec.

Notes. GARRETT (*in sched.*) recorded that the plant is night-flowering in Thailand.

RIDLEY (1925) gave the new name *C. malayense* to what he had previously identified as *C. orchidastrum* LINDL. However, he gave no characters by which these species could be separated.

In the neighbouring territories of Thailand and Indo-China CHAROENPHOL (1973) and GAGNEPAIN (1934) have continued to recognize *C. orchidastrum*, but I am following PANIGRAHI (1975) who considers that *C. orchidastrum sensu stricto* is confined to Africa, that the Indian material should be referred to *C. nimmonii* and *C. glaucum*, and that the SE. Asian material is *C. malayense*. Our species can, according to PANIGRAHI, be recognized *inter alia* by drying greenish brown or glaucous, in the leaves not being distinctly petioled and 3-5 cm broad, in the scape being up to 50 cm long and shorter than the leaves and in the bracts being up to 9 cm long. Few collections have been made of *C. malayense* and further field work is needed to confirm its status.

*C. longissimum* RIDL. (*J. Str. Br. R. As. Soc. n.* 49, 1907, 209) was described from Trang, Peninsular Thailand, close to the Malesian border. It closely resembles *C. malayense*. CHAROENPHOL distinguished these species on whether the inflorescence is erect and sometimes branched (*C. malayense*) or trailing on the ground and never branched (*C. longissimum*). The type of *C. longissimum* has not been seen, but specimens at Kew identified as such, and agreeing with the type description, are possibly sufficiently characterized by these inflorescence characters to retain it as a distinct taxon. Whether the differences are sufficient for specific rank must be left to future examination; it is provisionally kept distinct. It was not discussed by PANIGRAHI.

## 9. DIANELLA

LAMK [Encycl. 2 (1786) 276, *nom. inval.*] ex JUSS. *Gen. Pl.* (1789) 47; BAKER, *J. Linn. Soc. Bot.* 14 (1875) 574; BTH. *Fl. Austr.* 7 (1878) 13; BACK. *Handb. Fl. Java* 3 (1924) 53; KRAUSE in E. & P. *Nat. Pfl. Fam. ed.* 2, 15a (1930)



295; SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 163 (1940) 256; Blumea 6 (1948) 200; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 606. — *Rhuacophila* BL. En. Pl. Jav. (1827) 13. — **Fig. 9.**

Erect or climbing glabrous herbs. *Rhizome* short to stoloniferous. Roots fibrous. *Leaves* usually cauline and distichous or basally rosulate, linear, distally dorsiventral, in the lower parts sometimes laterally compressed and keeled and often forming a closed sheath at the base. *Inflorescence* a panicle. *Pedicels* solitary or few, usually in the axils of bracts, articulated immediately below the flower. *Perianth* segments free, 3–7-nerved, spreading or recurved, equal or subequal. *Filaments* filiform or linear, often swollen in the distal half, glabrous, attached to the receptacle or the inner whorl attached to the perianth segments; anthers basifixed, linear to oblong, dehiscent by an apical pore or by a slit which is initiated in an apical pore. *Ovary* superior, more or less sessile, globose, 3-celled; ovules axile, 4–8 in each locule; style filiform, simple, minutely capitate. *Fruit* a berry, usually shiny blue; perianth segments adhering, marcescent, not twisting after flowering; base of style persistent. Seeds globose or angled.

Distr. Continental Africa (one record), Madagascar, through India into China, throughout Malasia and Australia to New Zealand and the Pacific Islands (New Caledonia, Sandwich Is., Norfolk and Fiji).

Estimates of the number of species vary widely; there are possibly 20–30 spp. in all.

Ecol. Both in forest and in more open localities.

#### KEY TO THE SPECIES

1. Leaf bases strongly compressed and keeled. Leaves usually with minute teeth or prickles along the margin and abaxial surface of the midrib. Fertile bracts differing considerably in size from even the smaller leaves. Filaments strongly thickened at the apex under the anther . . . . . 1. *D. ensifolia*
1. Leaf bases obtuse in section, not keeled. Leaves always smooth. Fertile bracts grading into the leaves. Filaments widened about the middle . . . . . 2. *D. javanica*

1. *Dianella ensifolia* (L.) DC. in Redouté, Liliac. 1 (1802) t. 1, cf. COODE in Bosser c.s. Fl. Mascar. Lil. (1978) 32; MIQ. Fl. Ind. Bat. 3 (1859) 560; HEMSL. Rep. Chall. Bot. 1, 3 (1884) 201; RIDL. Mat. Fl. Mal. Pen. Monoc. 2 (1907) 92; LAUT. Bot. Jahrb. 50 (1913) 293; HALL. f. Nova Guinea 8 (1914) 995; MERR. En. Born. (1921) 114; En. Philip. 1 (1922) 203; RIDL. Fl. Mal. Pen. 4 (1924) 329; KRAUSE, Bot. Jahrb. 59 (1925) 551; MERR. Contr. Arn. Arb. 8 (1934) 18; WILD, Kew Bull. 8 (1953) 251; M. R. HENDERSON, Mal. Wild Flow. Monoc. (1954) 186, f. 110; BACK. & BAKH. f. Fl. Java 3 (1968) 87; STEEN. Mt. Fl. Java (1972) t. 28–1. — *Gladiolus odoratus indicus* RUMPH. Herb. Amb. 5 (1747) 185, t. 73. — *Dracaena ensifolia* LINNÉ, Mant. (1767) 63. — *Dianella nemorosa* LAMK, Encycl. 2 (1786) 276, *nom. inval.*; Tabl. Enc. 2 (1792) 388, t. 250, *nom. illeg.*; SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 163 (1940) 256; Blumea 6 (1948) 209, incl. many forms, l.c. 216–223. — *Dracaena ensata* THUNB. Diss. Bot. Drac. (1808) 4. — *Dianella montana* BL. En. Pl. Jav. 1 (1827) 12; HASSK. Tijd. Nat. Gesch. Phys. 11 (1844) 180; Pl. Jav. Rar. (1848) 114; MIQ. Fl. Ind. Bat. 3 (1859) 560; BACK. Handb. Fl. Java 3 (1924) 54. —

*D. odorata* [RUMPH.] BL. En. Pl. Jav. 1 (1827) 13; HALL. f. Nova Guinea 8 (1914) 996; MERR. Int. Rumph. (1917) 136; KRAUSE, Bot. Jahrb. 59 (1925) 550; SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 163 (1940) 258. — *D. revoluta* (non R. BR.) SCHAUER, Nov. Act. Ac. Nat. Cur. 19 (1843) Suppl. 1: 445; LAUT. Bot. Jahrb. 50 (1913) 293; MERR. En. Philip. 1 (1922) 203. — *D. bancana* MIQ. Fl. Ind. Bat. Suppl. (1861) 610; BACK. Handb. Fl. Java 3 (1924) 54. — *D. caerulea* (non SIMS, Bot. Mag. 15, 1801, t. 505) MERR. Philip. J. Sc. 2 (1907) Bot. 266; *ibid.* 5 (1910) Bot. 337; HALL. f. Nova Guinea 8 (1914) 993; GIBBS, Arfak (1917) 100; MERR. En. Philip. 1 (1922) 202; KRAUSE, Bot. Jahrb. 59 (1925) 552; HOLTHUIS, Blumea 5 (1942) 167. — *D. robusta* ELMER, Leaf. Philip. Bot. 5 (1913) 806. — *D. bambusifolia* HALL. f. Nova Guinea 8 (1914) 995, t. 182; KRAUSE, Bot. Jahrb. 59 (1925) 550. — *D. flabellata* HALL. f. l.c. 997, t. 183; KRAUSE, l.c. 549. — *D. carinata* HALL. f. l.c. 999, t. 186; KRAUSE, l.c. 550. — *D. parviflora* ZIPP. ex HALL. f. l.c. 998, t. 184; KRAUSE, l.c. 551. — *C. albiflora* HALL. f. l.c. 998, t. 185; KRAUSE, l.c. 551. — *D. monophylla* HALL. f. l.c. 1000, t. 188; KRAUSE, l.c. 551. — *D. serrulata* HALL. f. l.c. 1000, t. 187; KRAUSE,



Fig. 9. *Dianella javanica* (BL.) KUNTH, on Mt Kaba, S. Sumatra (Photogr. DE VOOGD).

*l.c.* 549. — *D. parviflora* RIDL. J. Fed. Mal. St. Mus. 6 (1915) 186. — *D. pullei* KRAUSE, Nova Guinea 14 (1924) 175; Bot. Jahrb. 59 (1925) 553. — *D. ledermannii* KRAUSE, Bot. Jahrb. 59 (1925) 549. — *D. monticola* KRAUSE, *l.c.* 553. — ? *D. levis* (non R. BR.) C. T. WHITE, Proc. Linn. Soc. N.S.W. 51 (1926) 298. — *D. sparsiflora* SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 163 (1940) 262. — *D. ensata* (THUNB.) R. J. HENDERSON, Taxon 26 (1977) 136.

Stem 0–1 m high, unbranched, rarely with a few branches. *Rhizome* horizontal, moderately branched. *Leaves* basal, scattered along the stem or in a terminal rosette, distichous, with a sheathing lower part, (25–)30–60(–100) cm by (4–)8–30 mm; above the base keeled and with the sides of the lamina becoming firmly appressed to one another and fused to form an isobilateral portion; distally with a dorsiventral linear or linear-lanceolate



lamina which is sometimes absent from the lower leaves, almost always with minute serrations or prickles along the midrib on the lower surface, with a conspicuous midrib and numerous smaller veins. *Inflorescence* exceeding the leaves, lax or with short terminal branches often c. 1–2 cm long, bearing up to 20 pedicels. Lower bracts usually narrowly linear-lanceolate and bilaterally compressed above the basal sheath like the leaves; bracts subtending pedicels 1–4(–7) mm long or rarely absent. *Pedicels* 4–15(–22) mm. *Perianth* segments blue, white, lilac or yellow, spreading, (4)–5–8(–9) mm long. *Filaments* often more than half as long as the perianth segments, filiform or narrowly linear, white or yellow with a yellow or orange, glabrous swelling below the anther. *Ovary* green,  $1\frac{1}{2}$ –2 mm long; ovules 4 in each locule; style green, white or blue, 4–6 mm long. *Fruit* shiny blue, 6–8(–11) mm  $\varnothing$ . Seeds several, 3–4 mm long.

*Distr.* Continental Africa (WILD, 1953), Madagascar, continental Asia (Himalayas, Burma, Thailand, Indo-China) to southern China (Yunnan, Hainan), Japan and Formosa, throughout *Malesia* to Australia (Northern Territory, Queensland, New South Wales), Tasmania, New Zealand and many Pacific islands.

*Ecol.* A highly adaptable species, occurring in habitats ranging from open grassland to primary forest, from sea-level to over 3000 m. *Fl.* Jan.–Dec.

*Vern.* Malaya: *benjuang*, *satagit*, *senjuang*, *siak-siak jantan*; Sumatra: (*akar*) *tu(n)daun*, *mentuntil*, *tengari*, *ukop*, Banka, *siak-siak*, Riouw, *sieuh*, Djambi, *sitanggit*, Batak, *sesiah*, Pasemah, *sitangie*, Indragiri; Java: *djamaka*, *d. putih*, *suliga*, S, *tegari*, J; Borneo: *labeh-labeh*, Dusun Penampang dial., *angkup-angkup*, Bokon dial., *tembalong tipoh*, Dusun dial.; Philippines: *abláas*, Bag., *bariubáru*, *oyon-oyon*, P.Bis., *duigau*, Ig., *hogangan*, If.; Moluccas: *mariuü*, Talaud; New Guinea: *suruma*; *bururl*, *tirambaramp*, Mendi, *buru-buru*, Biak dial., *moalengen*, Aiome, *tanglenu*, Wigote, Wapi lang., *sinda*, Mumuni, Orokaiva lang., *tsiri kande kande*, Hagen Subdistr., *bonkaige*, Sinasina lang., Nimai dial., *pfifiriki*, Kutubu lang., *kili-kili*, Bemi, *kikipatia*, Koroba Subdistr., *sabetari*, Rawa, *kilina*, Kajorin, *sarpeim*, Miwaute, Wapi lang., *pengeh-pengeh*, Maipa, Mekeo lang., *baibighegi*, Utukap, Miniafi lang.

*Notes.* BACKER (1924, 1968) recognized two species, *D. montana* and *D. bancana*, to include the material from Java, which he distinguished mainly on flower colour, venation of petals, and inflorescence form. However, the large number of intermediates makes this separation impracticable.

SCHLITTLER (1940) recognized 3 *spp.* in *Malesia* (*D. odorata*, *D. nemorosa* and *D. sparsiflora*), but in 1948 he reduced these to a single one under the name *D. nemorosa*, with 24 forms in *Malesia*.

Being a common species over a large area,

*D. ensifolia* is exceptionally well represented in herbaria and, despite its variability, I doubt that even with intensive field work distinct subspecific taxa can be defined.

2. *Dianella javanica* (BL.) KUNTH, En. Pl. 5 (1850) 52; MIQ. Fl. Ind. Bat. 3 (1859) 561; HALL. f. Nova Guinea 8 (1914) 995; MERR. En. BORN. (1921) 114; En. Philip. 1 (1922) 203; RIDL. Fl. Mal. Pen. 4 (1924) 328; BACK. Handb. Fl. Java 3 (1924) 53; KRAUSE, Bot. Jahrb. 59 (1925) 549; MERR. Contr. Arn. Arb. 8 (1934) 19; SCHLITTLER, Blumea 6 (1948) 206, incl. *f. stenophylla*, *alba et rubra* SCHLITTLER, l.c. 208; Mitt. Bot. Mus. Un. Zürich 207 (1957) 6, 11, map, 25; BACK. & BAKH. f. Fl. Java 3 (1968) 87; STEEN. Mt. Fl. Java (1972) t. 28–2. — *Rhuacophila javanica* BL. En. Pl. Jav. (1827) 14; RIDL. J. Linn. Soc. Bot. 42 (1914) 166; J. Fed. Mal. St. Mus. 6 (1915) 186. — *Rhuacophila celebica* BL. En. Pl. Jav. (1827) 14. — *Eustrephus javanicus* (BL.) D. DIETR. Syn. Pl. 2 (1840) 1117. — *Eustrephus celebicus* (BL.) D. DIETR. l.c. — *D. celebica* (BL.) KUNTH, En. Pl. 5 (1850) 45; MIQ. Fl. Ind. Bat. 3 (1859) 561. — *D. austro-caledonica* SEEM. Fl. Vit. (1868) 312; LAUT. Bot. Jahrb. 50 (1913) 294. — Fig. 9.

Stem always present, up to 2 m high, unbranched or branched. *Rhizome* horizontal, moderately branched. *Leaves* concentrated towards the ends of the branches, distichous, 12–35(–40) by  $\frac{3}{4}$ –2 $\frac{1}{2}$  cm, with a sheathing but not closed base which is continuous with the lamina, lacking a compressed and fused intermediate portion, lacking serrations or prickles; midrib usually more conspicuous than the many other veins. *Inflorescence* lax, exceeding the leaves. Bracts subtending branches of the inflorescences grading gradually in size into the foliage leaves, up to 25 by 3 cm, ovate to lanceolate not bilaterally compressed; bracts subtending the pedicels  $\frac{1}{2}$ –3(–5) mm long or absent. *Pedicels* 6–20 mm. *Perianth* segments blue (usually pale), white to yellow or lilac, spreading, (6)–8–12 mm long; outer whorl strongly cucullate at the apex. *Filaments* usually less than half as long as the perianth segments, white or yellow, filiform, usually with a distinct papillose fusiform swelling about the middle. *Ovary* green, c. 2 mm long; ovules c. 8–10 in each locule; style white or green 2–5 mm. *Fruit* green or yellow at first, sometimes (at least) becoming black, ellipsoid, 8–15 mm long, with up to 10 seeds. Seeds c.  $1\frac{1}{2}$  mm  $\varnothing$ .

*Distr.* Throughout *Malesia*, also in New Caledonia and Ile des Pins, and Fiji Is. (Viti Levu).

*Ecol.* Grows in a wide variety of habitats, including mossy forests, thickets, forest borders, on narrow open ridge-crests, in debris of craters, among rocks, on stream banks and in exposed places, locally common, (1000)–1500–3000 m. *Fl.* Jan.–Dec.

*Vern.* Java: *hadjèra*, S; Philippines: *kallawad*, If., *apilug*, *sapiláu*, *uráya*, Ig., *talobatub*, Bon.



Fig. 10. *Thysanotus tuberosus* R. BR. *a*. Habit,  $\times \frac{1}{4}$ , *b*. flower,  $\times 5$ , *c*. sexual organs,  $\times 10$ , *d*. fruit in persistent perianth,  $\times 5$ . — *T. chinensis* BTH. *e*. Habit,  $\times \frac{1}{2}$  (*a-d* BRASS 6517, *e* VAN ROYEN & SLEUMER 5632).



## 10. THYSANOTUS

R. BR. Prod. (1810) 282; BAKER, J. Linn. Soc. Bot. 15 (1876) 334; BTH. Fl. Austr. 7 (1878) 36; RIDL. Fl. Mal. Pen. 4 (1924) 328; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 285; EWART, Fl. Vict. (1930) 288; BLACK, Fl. S. Austr. 1 (1943) 190; PAYENS, Nova Guinea n.s. 8 (1957) 386; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 598, *nom. gen. cons.* — *Chlamysporum* SALISB. Parad. Lond. (1808) t. 103. — *Halongia* JEANPLONG, Act. Bot. Ac. Sc. Hung. 16 (1970) 293, f. 1–6. — **Fig. 10.**

Stemless herbs. *Rhizome* horizontal, very short. Roots fibrous or tuberous. *Leaves* basal, rosulate, filiform or linear, glabrous, expanding towards the base to form a sheath. *Inflorescence* a raceme, panicle or umbellate, erect or twining. *Pedicels* 1–7-nate, in the axils of bracts and associated with a few small bracts also apparently in the axil of the principal bract, or umbellate, articulated often in the median third. *Perianth* segments free, 3–5-nerved, spreading; outer whorl green; inner whorl usually blue to purple or violet, fringed. *Stamens* usually 6, rarely 3. *Filaments* linear, glabrous, attached to the perianth segments, bent over to one side of the ovary (BLACK, 1943); 3 often shorter; anthers basifixed, linear, curved dehiscent introrsely. *Ovary* superior, sessile, oblong to globose, 3-celled; ovules axile, 2 in each locule; style filiform, simple, minutely capitate. *Capsule* dehiscent loculicidally; perianth segments adhering, marcescent, twisting after flowering; style persistent. Seeds angled, with a fleshy white or orange strophiole.

Distr. Up to 30  *spp.*, all in Australia (all states, but especially Western Australia); in *Malesia*: 2 of these  *spp.*, one in New Guinea and another throughout Malesia as far as Thailand, Indo-China and southern China.

Ecol. A wide range of mostly open habitats from grasslands and sandy heaths to open forests, including both *Eucalyptus* savanna and pine forest.

Notes. The fleshy appendage of the seed has been referred to as a caruncle (*e.g.* BLACK, 1943), but it appears to be derived from the funicle rather than from the testa and I am, therefore, using the term strophiole as done by PAYENS (1957).

The term 'cluster' is sometimes used in preference to umbel as in some material the inflorescence appears umbellate but in other material the pedicels arise from a short but distinct axis.

## KEY TO THE SPECIES

1. Roots lacking tubers. Inflorescence a simple umbel . . . . . 1. *T. chinensis*  
1. Roots with tubers. Inflorescence a panicle, the branches terminated by umbels . . . 2. *T. tuberosus*

1. *Thysanotus chinensis* BTH. Fl. Hongk. (1861) 372; BAKER, J. Linn. Soc. Bot. 15 (1876) 337; HALL. f. Nova Guinea 8 (1914) 994; MERR. En. Philip. 1 (1922) 202; KRAUSE, Bot. Jahrb. 59 (1925) 548; GARDN. En. Pl. Austr. Occid. (1931) 18; SCHLITTLER, Mitt. Bot. Mus. Un. Zürich 207 (1957) 6, map; PAYENS, Nova Guinea n.s. 8 (1957) 386; STEEN. Blumea 20 (1972) 433. — *T. chrysanthus* F.v.M. [in BTH. Fl. Hongk. (1861) 372, *nomen*] Fragm. 5 (1866) 202; BTH. Fl. Austr. 7 (1878) 40; NAVES, Nov. App. (1880) 266; VIDAL, Phan. Cuming. (1885) 153; BAILEY, Queensl. Fl. 5 (1902) 1629. — *Chlamysporum chrysanthum* (F.v.M.) O. K. Rev. Gen. Pl. 2 (1891) 708. — *T. siamensis* RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 209; Fl.

Mal. Pen. 4 (1924) 328. — *Halongia purpurea* JEANPLONG, Act. Bot. Ac. Sc. Hung. 16 (1970) 296, f. 1–6. — **Fig. 10e.**

Roots fibrous. *Leaves* c. 5 to numerous, erect, often shallowly channelled, usually 15–40 cm, up to c. 1 mm wide. Peduncle about as long as the leaves, straight, unbranched, terminating in a 2–6(–12)-flowered cluster. Bracts with scarious margins, 2–4 mm long. *Pedicels* 1–2 cm, articulated in the basal third, erect in bud, usually spreading or recurving in fruit. Outer *perianth* segments (? always) green, with a scarious, white margin, 6–9 by 2–3 mm; inner segments pale blue to purple or light violet, with inturned usually fringed margins, 6–9 by 3–5 mm. *Filaments* 1½–2 mm,



Fig. 11. *Tricoryne platyptera* RCHB. a. Habit,  $\times \frac{1}{4}$ , b. flower,  $\times 2$ , c. withered flower,  $\times 4$ , d. stamen,  $\times 20$ , e. fruit,  $\times 5$  (NGF 38690, PULLEN 7090).



the outer whorl shorter than the inner; anthers  $1\frac{1}{2}$ –3 mm long, the outer shorter than the inner. *Ovary* c. 1 mm long; style c. 3–4 mm. *Capsule* oblong, 4–5 mm long. Seeds c.  $1\frac{1}{2}$  mm long.

Distr. Australia (Western Australia and Northern Territory); in *Malesia*: New Guinea (West New Guinea and Papua), SE. Moluccas (Aru Is.: Tranggan), Celebes (Masamba), Philippines (Luzon, Mindanao), Lesser Sunda Is. (Flores), onto continental SE. Asia: S. Peninsular Thailand (Setul), Indo-China (Tonkin), S. China (incl. Hong Kong).

Ecol. Open grassland, in grassy pine forest, most frequently in open savanna, in New Guinea of *Melaleuca*, etc., in places subject to a moderate to strong dry season, from close to sea-level up to 1600 m. *Fl.* Dec.–Aug.

**2. *Thysanotus tuberosus*** R. BR. Prod. (1810) 282; BAKER, J. Linn. Soc. Bot. 15 (1876) 335; BTH. Fl. Austr. 7 (1878) 41; EWART, Fl. Vict. (1930) 289; GARDN. En. Pl. Austr. Occid. (1931) 18; BRASS, J. Arn. Arb. 19 (1938) 190; BLACK, Fl. S. Austr. 1 (1943) 191; PAYENS, Nova Guinea n.s. 8 (1957) 387; BURB. & GRAY, Fl. A.C.T. (1970) 102. — *Chlamysporum tuberosum* (R. BR.) O. K. Rev. Gen. Pl. (1891) 708. — **Fig. 10a–d.**

Roots partly fibrous, bearing spindle-shaped distant tubers 10–25 mm long. *Leaves* 2–6, erect, linear to terete, 20–50 cm by up to c. 1 mm broad. Peduncle about as long as the leaves or up to 50% longer, usually with 1–6 branches; main axis

and branches each terminating in a 2–6(–20)-flowered cluster; 1–3(–8) flowered fascicles of flowers usually also present in the axils of bracts along the main axis and branches. Bracts usually with scarious margins, the lowest 3–60(–80) mm long; the upper shorter. *Pedicels* 7–17 mm, articulation usually below the centre, erect to spreading. Outer *perianth* segments purple with a scarious pale margin, 7–14 by 2–3 mm; inner segments purple with inturning fringed margin, 7–15 by  $2\frac{1}{2}$ –5 mm. *Filaments* 1–2 mm, those of the outer whorl often shorter than the inner; anthers 2–4 mm long; outer often shorter than the inner. *Ovary* 1– $1\frac{1}{2}$  mm long; style (2–)3–5 mm. *Capsule* oblong, c. 5–6 mm long. Seeds up to 2 mm long.

Distr. Australia (all states except Tasmania) and S. Papua New Guinea (Western District: Wassi Kussa; Mabaduan).

Ecol. Common grass associate in lowland savanna forest on poorly drained flats, subject to a distinct dry season. *Fl.* Dec.–April. In Australia found in exposed localities up to 500 m.

Notes. VAN ROYEN recorded in Queensland that the outside of the flowers was white with a green midrib and the anthers dark purplish green.

PAYENS (1957) recognized two varieties separable on flower size. Both occur in Australia but only *var. parviflora* BTH. in Papua. The material available is insufficient to justify recognition of these varieties.

Six other synonyms based on *extra-Malesian* material are omitted from the synonymy.

## 11. TRICORYNE

R. BR. Prod. (1810) 278; BAKER, J. Linn. Soc. Bot. 15 (1876) 361; BTH. Fl. Austr. 7 (1878) 50; BAILEY, Queensl. Fl. 5 (1902) 1636; EWART, Fl. Vict. (1930) 287; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 287; BLACK, Fl. S. Austr. 1 (1943) 192; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 602. — **Fig. 11.**

Erect, glabrous or variously hairy herbs; stems green, terete, angled or flattened and leaf-like. *Rhizome* horizontal or erect, often very short; roots thick or fibrous. *Leaves* basal and/or cauline, more or less linear or reduced to scales, alternate, often amplexicaul at the base. *Inflorescence* of terminal umbels surrounded by small scarious bracts and outer larger, sometimes leaf-like bracts. *Pedicels* articulated just below the flower. *Perianth* segments free or shortly connate, equal or subequal, with 3 or 5 (less often 7) prominent veins, spreading. *Filaments* filiform, with a dense tuft of hairs in the distal part, attached to the receptacle; anthers basifixed, linear to oblong; introrse. *Ovary* superior, sessile, deeply 3-lobed, 3-celled; ovules basal, 2 in each locule; style filiform, simple, minutely capitate. *Fruit* consisting of (1–)3 indehiscent nutlets; perianth segments adhering, marcescent, twisting spirally after flowering. Seeds subglobose.

Distr. In Australia (all states) 6 *spp.*, of which one in *Malesia*: S. Papua New Guinea.

Ecol. Low altitude plant. BAILEY recorded most of the Queensland species from 'sandy shores' and specimen annotations suggest a preference for sandy soils in grassland or savanna.

Note. The terms 'stem' and 'leaves' give some difficulty as the aerial shoot might be better regarded as an inflorescence often bearing leaf-like bracts rather than as a vegetative shoot with leaves.

1. *Tricoryne platyptera* RCHB. Syst. Pflanz. (1871) 72; BTH. Fl. Austr. 7 (1878) 51; BAILEY, Queensl. Fl. 5 (1902) 1636; Compr. Cat. Queensl. Pl. (1913) 559, f. 539; BRASS, J. Arn. Arb. 19 (1938) 190; PAYENS, Nova Guinea n.s. 8 (1957) 385. — *T. pterocaulon* BAKER, J. Linn. Soc. Bot. 15 (1876) 363. — Fig. 11.

Virgate, erect or subscandent herb. Stems and branches strongly flattened (winged), terete towards the base of the plant, glabrous, 25–80 cm high; flattened portions with a prominent midrib, c. 2–8 mm broad. *Rhizome* short; roots rather thick. *Leaves* cauline, narrowly triangular, scale-like, up to 12(–25) mm long. Bracts 1–4 mm long. *Pedicels* usually 5–12(–15) in number, (2–)4–12 mm.

*Perianth* segments yellow, oblong or elliptic-oblong, with a scarious margin, 6–8(–10) by up to c. 3 mm; those of the outer whorl usually with (3–)5(–7) veins; those of the inner whorl slightly narrower, with 3 veins. *Filaments*  $2\frac{1}{2}$ –3 mm, yellow; anthers c. 1–1 $\frac{1}{4}$  mm long. *Ovary* c.  $\frac{1}{2}$  mm long; style  $3\frac{1}{2}$ –4 mm. Nutlets green.

Distr. Australia (tropical Queensland) and *Malesia*: S. Papua New Guinea (Western District; Wassi Kussa area), Thursday I.

Ecol. In New Guinea in savanna with *Melaleuca* and *Acacia*, in lowland savanna-woodland on sour grey soil and in grass of creek flats, subject to a strong dry season. *Fl.* Dec.–Jan., July–Aug.

In N. Queensland found up to 950 m.

## 12. LILIUM

LINNÉ, Sp. Pl. (1753) 302; Gen. Pl. ed. 5 (1754) 143; BAKER, J. Linn. Soc. Bot. 14 (1875) 225; ELWES, Monogr. genus *Lilium* (1880); WILSON, Lilies of E. Asia (1925); KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 329; DRYSDALE WOODCOCK & STEARN, Lilies of the World (1950); SEALY, Kew Bull. 5 (1950) 273; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 609.

Erect, usually glabrous herbs. Bulb scaly; roots thick, produced from below the bulb and in some species from the base of the aerial stem. Aerial stem annual, erect, usually unbranched. *Leaves* cauline, alternate or verticillate, linear or broadly flattened, usually sessile, sometimes with bulbils in their axils. *Flowers* solitary and terminal, or in a racemose inflorescence of solitary flowers in the axils of the often leaf-like bracts. *Pedicels* erect to cernuous, not articulated. *Perianth* segments free,  $\pm$  equal, infundibuliform or campanulate, sometimes clawed, sometimes adhering and forming a tube, spreading or recurving distally, with a nectariferous longitudinal furrow towards the base. *Filaments* filiform or subulate, attached to the receptacle or to the base of the segments; anthers dorsifixed, linear, introrse, versatile. *Ovary* superior, sessile, oblong to obovoid, 3-celled; ovules axile,  $\infty$ ; style terete sometimes clavate, 3-lobed. *Capsule* coriaceous, loculicidal, perianth deciduous. Seeds flat.

Distr. Widespread with possibly 80  *spp.* in the temperate regions of North America, Europe and Asia (also Taiwan); in *Malesia*: Philippines.

Ecol. The species occupy a wide range of habitats, including open areas and woods.

Note. Many species are of horticultural importance.

### KEY TO THE SPECIES

- |   |                            |
|---|----------------------------|
| 1. Leaves 6–15 mm broad. Nectariferous furrow on perianth segments glabrous . . . | 1. <i>L. longiflorum</i>   |
| 1. Leaves 2–4 mm broad. Nectariferous furrow on perianth segments papillose . . . | 2. <i>L. philippinense</i> |

1. *Lilium longiflorum* THUNB. Trans. Linn. Soc. 2 (1794) 333; ELWES, Monogr. genus *Lilium* (1880) t. 7; MERR. En. Philip. 1 (1922) 204; BACK. Handb. Fl. Java 3 (1924) 62; WILSON, Lilies of E. Asia

(1925) 23; DRYSDALE WOODCOCK & STEARN, Lilies of the World (1950) 253; HATUS. Mem. Fac. Agric. Kagoshima Un. 5 (1966) 62, *err. longifolium*; BACK. & BAKH. f. Fl. Java 3 (1968) 90.



Bulb usually subglobose, often yellowish, up to  $6\frac{1}{2}$  cm  $\varnothing$ ; scales closely imbricate. Stem 30–90 (–100) cm high, smooth, green, producing roots above the bulb. *Leaves* alternate, 20–40(–60), sessile, lanceolate or oblong-lanceolate, attenuate, with up to 20 or more veins of which up to 7 are usually more conspicuous, the largest on each plant up to 15 by  $1\frac{1}{2}$  cm, usually much smaller distally. *Flowers* often solitary, but up to at least 7, white, horizontal, (12–)15–20 cm long, infundibuliform, the tube (in dried material) 9–12 mm  $\varnothing$ . *Perianth* segments not clawed, reflexed distally; nectariferous furrow glabrous. *Filaments* filiform above, linear below, in dried material 9–14 cm; anthers 7–12 mm long; pollen yellow. *Style* 8–12 cm; stigma deeply 3-lobed. *Capsule* c. 4–6 cm long.

Distr. China, Japan and Taiwan; in *Malesia*: Philippines: Batan Is. and Y'ami (N of Luzon), cf. MERRILL and HATUSIMA.

Native country not exactly known, possibly naturalized over part of its range.

Ecol. Open grassy slopes at low altitude.

Vern. *Easter lily*, E; *teppo-yuri*, Japan; Philippines: *vonitan*, Iv.

Note. Stated by DRYSDALE WOODCOCK & STEARN to be commercially the most important species of *Lilium*, with numerous cultivated forms.

2. *Lilium philippinense* BAKER, Gard. Chron. (1873) 1141, f. 243; J. Linn. Soc. Bot. 14 (1875) 228

(*'philippense'*); CURTIS, Bot. Mag. III, 32 (1876) t. 6250; ELWES, Monogr. genus *Lilium* (1880) t. 3; MERR. Philip. J. Sc. 5 (1910) Bot. 337; En. Philip. 1 (1922) 204; WILSON, Lilies of E. Asia (1925) 20; DRYSDALE WOODCOCK & STEARN, Lilies of the World (1950) 311.

Bulb subglobose, whitish, c.  $3\frac{1}{2}$ –4 cm  $\varnothing$ ; scales unknown. Stem 30–90 cm high, smooth, green or mottled with purple, producing roots above the bulb. *Leaves* alternate, 30–40, linear, attenuate, with up to 7 veins of which 1 or 3 are more conspicuous, 8–17 cm by 2–4 mm. *Flowers* 1 or 2, white, with green and reddish outside towards the base, horizontal, (10–)14–25 cm long, infundibuliform, the tube (in dried material) 8–12 mm  $\varnothing$ . *Perianth* segments not clawed, spreading distally; nectariferous furrow papillose. *Filaments* linear in dried material, 13–17 cm; anthers 5–15 mm long; pollen yellow. *Style*  $10\frac{1}{2}$ –16 cm; stigma deeply 3-lobed. *Capsule* c. 5 cm long.

Distr. Taiwan and *Malesia*: Philippines: North Luzon (Bontoc, Benguet and Pangasinan Prov.).

Ecol. Open grassy slopes in the pine region, 1100–2300 m. *Fl.* May, *fr.* Oct.

Vern. Philippines: *kanyon*, Ilk., *luplupak*, *soyasoi*, *tubtubkau*, Ig., *tuktukpau*, Bon.

Note. Except for the presence of papillae on the nectariferous furrow hard to distinguish in flower from *L. longiflorum*.

### 13. ASPARAGUS

LINNÉ, Sp. Pl. (1753) 313; Gen. Pl. ed. 5 (1754) 147; BAKER, J. Linn. Soc. Bot. 14 (1875) 594; BTH. Fl. Austr. 7 (1878) 17; BAKER, Fl. Trop. Afr. 7 (1898) 425; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 362; HUTCH. Fam. Fl. Pl. ed. 2, 2 (1959) 608; JESSOP, Bothalia 9 (1966) 31; BACK. & BAKH. f. Fl. Java 3 (1968) 92. — *Asparagopsis* KUNTH, Abh. K. Ak. Wiss. Berlin (1842) 35.

Climbing or erect, glabrous or pubescent, softly woody plants usually with bisexual flowers, rarely dioecious. *Rhizome* perennial; roots mostly thick and often tuberous. Aerial stems annual or perennial, usually much-branched; branches sometimes similar to the main stems and sometimes morphologically distinct. *Leaves* cauline, alternate, scale-like, usually brown and at least partially scarious, often with a spine from the abaxial surface; leaves of the rhizome scale-like, lacking a spine. Leaf-like structures (*cladodes*) solitary or fascicled, flat, angled or terete, arising in the axils of cauline leaves but sometimes absent from flower-bearing branchlets. *Pedicels* solitary or fascicled in the axils of the cauline leaves, articulated. *Perianth* segments free or minutely connate, equal or subequal, 1-veined, white or nearly so, often with a green longitudinal band on the abaxial surface, spreading or less often reflexed. *Filaments* flattened, attached to the perianth segments; anthers dorsifixed, oblong, introrse. *Ovary* superior,  $\pm$  sessile, 3-celled; ovules axile, 2 to few; style usually filiform with 3 short branches, less often divided

nearly to the base. *Fruit* usually a red 1- to few-seeded berry; perianth not usually persistent. Seeds globose or partly angled.

Distr. Widespread in Europe, Africa, Madagascar, and Asia; in Malesia 2 *spp.*, one of which is widespread in the Old World and the single one known from Australia.

There are probably fewer than 100 *spp.*, but the taxonomy of the genus is poorly understood.

Ecol. Species have a preference for arid areas in the open and for savanna, but some occur in damp forests.

Notes. The morphology of the spines has been discussed by CUSSET & TRAN (Bull. Soc. Bot. Fr. 113, 1966, 151). The nature of the leaf-like organs (cladodes) is controversial. They are most frequently treated as axillary structures, *i.e.* modified branches (*e.g.* KAUSMANN, Bot. Stud. 3, 1955), and my own work confirms this. However, ARBER (Monocotyledons: a morphological study, 1925) believed that in a few species they were in fact leaves, while SCHLITTLER (Bot. Jahrb. 79, 1959, 428) concluded that they are leaves in all species.

#### KEY TO THE SPECIES

1. Flowers unisexual, borne at normal vegetative nodes. Cladodes usually flat, less often triquetrous . . . 1. *A. cochinchinensis*
1. Flowers bisexual, usually on branches lacking cladodes. Cladodes triquetrous . . . 2. *A. racemosus*

1. *Asparagus cochinchinensis* (LOUR.) MERR. Philip. J. Sc. 15 (1919) Bot. 230; En. Philip. 1 (1922) 206; GAGNEP. Fl. Gén. I.-C. 6 (1934) 780; MERR. Comm. Lour. (1935) 108; MAKINO, Ill. Fl. Japan (1954) 735. — *Melanthium cochinchinense* LOUR. Fl. Coch. (1790) 216. — *A. lucidus* LINDL. Bot. Reg. 30 (1844) Misc. 29; BAKER, J. Linn. Soc. Bot. 14 (1875) 605; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 96, *incl. var. dolichocladus* MERR. & ROLFE.

Plant dioecious. Stems glabrous, erect, procumbent or climbing, shallowly ridged; branches numerous, usually simple, arising singly, less than 10(–30) cm long, spreading or erect-spreading, often straight. Roots with distant, elongate tubers. Scale-leaves with scariosus portion less than 5(–8) mm long; spines absent on branches, poorly developed or up to 5 mm long on main axes. Cladodes present on branches and towards the ends of stems, flat, or 3-angled, 1–3-nate, linear-arcuate, 5–15(–40) by  $\frac{1}{2}$ –1 $\frac{1}{2}$  mm. Pedicels 1- or 2(–3)-nate, arising from the axils of scale-leaves subtending cladodes, articulated near or above the middle, 2–3(–6) mm long. Perianth segments yellow-green, pale green or white, spreading similar, oblong-elliptic, *c.* 2–3 $\frac{1}{2}$  mm long. — ♂ *Flowers*: filaments shorter than the perianth segments, cuneate from a broad base; anthers nearly 1 mm long (one specimen); ovary rudimentary. — ♀ *Flowers*: filaments *c.* half the length of the perianth segments; anthers rudimentary; ovary obovoid, 1 $\frac{1}{2}$ –2 mm long; style *c.*  $\frac{1}{2}$  mm, with 3 stigmatic ridges; ovules 2 per locule. Berry green when ripe, *c.* 4–7 mm Ø. Seeds 1–4, globose or angled, *c.* 2–3 mm Ø.

Distr. Korea, Japan, Ryu Kyu Is., S. China, Indo-China, Taiwan; in Malesia: Philippines (N. Luzon: Benguet Prov.), one record (LOHER 1928), probably from above 1200 m.

Ecol. There are several records from within the spray zone on coral or limestone substrates; also in

bush up to at least 200 m, but no ecological details known from the Philippines.

Notes. The recorded flower colours may be misleading. It is possible that the segments are white with a green or yellow-green band.

GAGNEPAIN recorded that the flowers were unisexual. I have seen insufficient material to determine whether the plants are always dioecious or to confirm that the flowers are always functionally unisexual, but in all flowers I examined one sex appeared to be rudimentary.

2. *Asparagus racemosus* WILLD. Sp. Pl. 2 (1799) 152; BAKER, J. Linn. Soc. Bot. 14 (1875) 623; BTH. Fl. Austr. 7 (1878) 17; ENGL. Bot. Jahrb. 7 (1886) 448; RIDL. Fl. Mal. Pen. 4 (1924) 331; BACK. Handb. Fl. Java 3 (1924) 72; HEYNE, Nutt. Pl. (1927) 444; H. PERRIER, Fl. Madag. fam. 40 (1938) 21; STEEN. Atlas Trop. Nederl. (1938) map 7<sup>2</sup>; JESSOP, Bothalia 9 (1966) 72; HUTCH. & DALZ. Fl. W. Trop. Afr. ed. 2, 3 (1968) 93; BACK. & BAKH. f. Fl. Java 3 (1968) 93. — *A. dubius* DECNE, Nouv. Ann. Mus. Paris 3 (1834) 363; Herb. Timor. Descr. (1835) 35; SPAN. Linnaea 15 (1941) 476, added *A. penduliflorus* ZIPP., *nomen, in syn.* — *Asparagus decaisnei* KUNTH, En. Pl. 5 (1850) 103, *nom. illeg.*; ZOLL. Syst. Verz. 1 (1854) 67; MIQ. Fl. Ind. Bat. 3 (1859) 562; RIDL. in Forbes, Wand. (1885) 520. — *Asparagopsis schoberioides* KUNTH, En. Pl. 5 (1850) 70; IL'IN, Fl. U.S.S.R. 4 (1968) 328. — *Asparagopsis javanica* KUNTH, En. Pl. 5 (1850) 100; ZOLL. Syst. Verz. 1 (1854) 67; MIQ. Fl. Ind. Bat. 3 (1859) 562.

Plant with bisexual flowers. Stems glabrous, usually climbing, up to 2–3 m high or more, smooth or grooved, in their lower part unbranched; branches numerous and branched; solitary; final branches usually 1–4-nate, up to 5(–10) cm long, spreading or ascending, straight. Roots with distant, elongate tubers. Scale-leaves



with scarious portion up to 5(–10) mm long and spine usually absent on final branches, up to 5(–10) mm long. *Cladodes* present mainly on branches and towards the ends of stems, triquetrous, linear-crenate, 1–3(–4)-nate, (7–)10–25 (–40) mm long, rarely over 1 mm broad. *Pedicels* 1- or 2-nate, usually on branches 2–6 mm long lacking cladodes, less often on normal branches, articulated usually near the middle, 3–5 mm long. *Flowers* bisexual, scented. *Perianth* segments white with a green band, spreading similar oblong to obovate-oblong, 2–3(–4) mm long. *Filaments* shorter than or about the same length as the perianth segments; anthers *c.* 0.2–0.3 mm long. *Ovary* obovoid, *c.* 1½ mm long; style *c.* ½ mm, with 3 stigmatic ridges or 3 short branches; ovules 2 per locule. *Berry* red when ripe, *c.* 4–6 mm Ø. Seeds 1–3, globose or angled, *c.* 2–3 mm Ø.

*Distr.* Widespread in Africa including the southern Cape, Guinea and Madagascar, through southern Asia into China, in South Malesia and the northern states of Australia; in *Malesia*: Malay Peninsula (Langkawi, on limestone rocks), Java (in the western half only on the Northcoast, in E on both sides; also Madura and Kangean Is.), Lesser Sunda Is. (Lombok, Sumba, Sumbawa, Flores, Timor), and SE. Moluccas (Tenimber Is.).

The range in Malesia is distinctly disjunct on both ends which is due to its drought preference;

it is absent from the Sundaland rain-forest core.

*Ecol.* In Malesia a distinct drought-loving plant and bound to the seasonal areas, in Java to the zone with at most 20 rainy days in the 4 driest consecutive months of the year, mostly in coastal areas, in sunny thickets and on dunes, in monsoon forest with *Bambusa spinosa*, *Acacia leucophloea*, etc., predominantly in the lowland, but ascending to *c.* 1150 m (BACKER). *Fl.* mostly Aug.–Jan.

*Vern.* *Christusdoorn*, D; *bek bun*, Chinese; Java: *sangga langit*, J; Timor: *niesie saub*, *nônôsan*; Tenimber Is.: *skikirie*, Saumlak.

*Notes.* There are many synonyms from Africa, Asia and Australia, but none are known to have been used for the Malesian area.

*A. racemosus* is closely allied to *A. cochinchinensis* and can only be distinguished by a combination of characters. In Malesia they are geographically separated but until a revision of the genus, at least in Asia, is undertaken the taxonomy of this group must remain uncertain.

#### Excluded

According to MERRILL (En. Philip. 1, 1922, 206) NAVES (Nov. App. 1880, 264) has credited *A. declinatus* L. and *A. racemosus* WILLD. to the Philippine flora, but both were apparently admitted on erroneous identifications.

### 14. DISPORUM

SALISB. Trans. Hort. Soc. 1 (1812) 331; D. DON, Trans. Linn. Soc. Lond. 18 (1841) 513; BAKER, J. Linn. Soc. Bot. 14 (1875) 588; HOOK. *f.* Fl. Br. Ind. 6 (1894) 359; BACK. Handb. Fl. Java 3 (1924) 73; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 368. — *Lethea* NORONA, Verh. Bat. Gen. ed. 1, 5 (1790) Art. 4, 2, *nomen*. — *Drapiezia* BL. En. Pl. Jav. (1827) 8. — **Fig. 12.**

Glabrous rhizomatous herbs. Aerial stems annual, erect, branched. *Leaves* cauline; the lower brown and scale-like with a sheathing base; the others alternate becoming opposite distally, flat, with many veins, petioled, usually ovate, obtuse at base. *Peduncles* terminating vegetative branches, not articulated, bearing 1–6 nutant flowers in an umbel. *Perianth* segments free, equal or subequal, erect or distally recurved, several-veined, usually saccate or spurred at the base. *Filaments* linear to lanceolate, attached to the receptacle or the base of the perianth; anthers dorsifixed, linear-oblong, extrorse. *Ovary* superior, sessile, ovoid to obovoid, 3-celled; ovules axile, 2 per cell; style filiform, with 3 recurved stigmatic branches. *Fruit* a 1–3-seeded berry.

*Distr.* Approximately 30 *spp.* currently recognized in the western U.S.A. and Canada, Japan, China, northern Deccan Peninsula, through Thailand to *West Malesia*: Malay Peninsula, Sumatra, Java, and Bali.

In my opinion it is highly unlikely that more than half of these will be recognized after critical revision. *Ecol.* Typical forest plants.

*Note.* BACKER *l.c.* pointed to the peculiar sympodial structure of the stem.

1. *Disporum cantoniense* (LOUR.) MERR. Philip. J. Sc. 15 (1919) 229; MERR. Comm. Lour. (1935) 109. — *Fritillaria cantoniensis* LOUR. Fl. Coch. (1790) 206. — *Uvularia chinensis* KER-GAWL. Bot. Mag. (1806) t. 916. — *D. pullum* SALISB. Trans. Hort. Soc. 1 (1812) 331; HASSK. Pl. Jav. Rar. (1848) 105; MIQ. Fl. Ind. Bat. 3 (1859) 552; BAKER, J. Linn. Soc. Bot. 14 (1875) 589; HOOK. f. Fl. Br. Ind. 6 (1892) 360; RIDL. J. Fed. Mal. St. Mus. 4 (1909) 82, incl. var. *multiflorum* RIDL.; KOORD. Fl. Tjib. 1 (1922) 47; RIDL. Fl. Mal. Pen. 4 (1924) 338; HEND.

Mal. Wild Flow. Monoc. (1954) 185, f. 109; CHAROENPHOL, Thai For. Bull. 8 (1974) 89. — *Drapiezia multiflora* BL. En. Pl. Jav. (1827) 8; (1974) 89. — *Drapiezia multiflora* BL. En. Pl. Jav. (1827) 8; JUNGH. Java ed. 2 (neerl.) 1 (1853) 522; ZOLL. Syst. Verz. 1 (1854) 66, incl. var. *albiflora* ZOLL. — *D. leschenaultianum* D. DON, Proc. Linn. Soc. 1 (1839) 45; Trans. Linn. Soc. 18 (1841) 518; MERR. Contr. Arn. Arb. 8 (1934) 19. — *D. horsfieldii* D. DON, Proc. Linn. Soc. 1 (1839) 45 (WALLICH 5088D). — *Streptopus multiflorus* (BL.)



Fig. 12. *Disporum cantoniense* (LOUR.) MERR. a. Habit,  $\times 3/4$ , b. flower of the spurred form, c. ditto of the non-spurred form, both  $\times 2\frac{1}{2}$ , d. gynoecium, e. stamen, both  $\times 5$ , f. fruit,  $\times 1\frac{1}{2}$  (drawn from various collections).



D. DIETR. Syn. Pl. 2 (1840) 1121. — *D. multiflorum* (BL.) D. DON, Trans. Linn. Soc. 18 (1841) 518; MIQ. Fl. Ind. Bat. 3 (1859) 552. — *D. calcaratum* D. DON, Trans. Linn. Soc. 18 (1841) 516; BAKER, J. Linn. Soc. Bot. 14 (1875) 588; HOOK. f. Fl. Br. Ind. 6 (1892) 359; CHAROENPHOL, Thai For. Bull. 8 (1974) 89. — *Uvularia multiflora* (BL.) KUNTH, En. Pl. 4 (1843) 207. — *D. chinense* (KER-GAWL.) O. K. Rev. Gen. Pl. 2 (1891) 708; BACK. Handb. Fl. Java 3 (1924) 73; DOCT. v. LEEUWEN, Verh. Kon. Ak. Wet. A'dam sect. II, 31 (1933) 147; BACK. & BAKH. f. Fl. Java 3 (1968) 94. — **Fig. 12.**

Stems erect, often 45–80 cm high, up to 2½ m, branched only in the upper half; branches erect-spreading, becoming flexuose distally. Roots fibrous or slightly thickened but not tuberous. *Leaves* usually ovate, less often oblong or lanceolate, rarely suborbicular, acuminate, 6½–17 by 2½–9 cm, with 5–9 veins prominent on the lower surface and numerous finer veins; petiole to 8 mm. *Inflorescence* an umbel of 2–7 flowers terminating a short branch which arises opposite a leaf and bears a single sometimes somewhat reduced leaf; peduncle 0–3½ cm; pedicels 1–4 cm. *Perianth* segments lanceolate to oblanceolate, acute, keeled below and usually saccate or less often with a spur to 5 mm long at the base, white, greenish to purple, 1–2(–2½) cm long. *Filaments* linear to lanceolate, often less than half as long as the

perianth; anthers bright yellow, 2½–4 mm long. *Berry* bluish black, 7–10 mm Ø. Seeds c. 3 mm Ø. Distr. SE. Asia from the northern Deccan Peninsula to southern China and Japan; in *Malesia*: Malay Peninsula (Perak, Pahang) and throughout Sumatra, Java, and Bali.

Ecol. In both primary and secondary forest, rarely in the open, (700–)1000–2550 m; especially common in W. Java. *Fl.* Jan.–Dec. DOCTERS VAN LEEUWEN *l.c.* observed the flowers to be protogynous; self-pollination is possible but bumblebees also regularly visit the flowers.

Vern. Java: *baradja lintang*, *kamalakian*, *kibeunteur areuj*, (ki)tamiang, *lili leuweung*, *radja lintang*, *tangkal milon*, S. *ègèr ègèr*, *glinggangan*, *lenguk*, *srintil*, *tombagan*, J; N. Sumatra: *si-demsapo*, *sumbul sumbul*, Karo-Batak, *kayu (si-mar)soma-soma*, S.

Notes. Variation in the length of the spur has been used in segregating species, but BACKER recognized the continuity of this gradation in Javanese material. Some Javanese plants have spurs as long as those in typical '*D. calcaratum*'.

Branching is partly sympodial. Short terminal axes bear the umbel. Continuation of growth of the aerial shoot is by a branch arising in the axil of the second leaf below the umbel. The node separating two leaves associated with the inflorescence is sometimes so short that the leaves appear opposite.

## 15. DISPOROPSIS

HANCE, J. Bot. 21 (1883) 278; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 370; NAKAI, J. Jap. Bot. 12 (1936) 147; CHANG & HSU, Taiwania 19 (1974) 64. — **Fig. 13.**

Glabrous rhizomatous herbs. Aerial stems annual, erect, unbranched. *Leaves* cauline, alternate, flat, with many veins, petioled, entire, ovate to oblong, obtuse or subcuneate at the base; brown scale-like leaves on the rhizome, less often also at the base of the aerial stems. *Flowers* solitary in the axils of the leaves, nutant. *Pedicels* articulated. *Perianth* campanulate; segments 3–5, fused, equal, viscid, saccate at the base. *Filaments* expanded to form a corona attached to the perianth; anthers dorsifixed, sagittate, introrse. *Ovary* superior, sessile, ovoid, 3-celled; ovules axile, 4–6 per cell; style short and thick, with simple or 3-lobed stigma. *Fruit* a 1–5-seeded berry.

Distr. Probably 4 or 5 *spp.* from Thailand, Indo-China, southern China, Taiwan; in *Malesia*: Philippines.

Ecol. Forests, usually in the mountains.

1. *Disporopsis fusco-picta* HANCE, J. Bot. 21 (1883) 278. — *Disporum pullum* (non SALISB.) MERR. Philip. J. Sc. 1 (1906) Suppl. 182. — *Disporum luzoniense* MERR. Philip. J. Sc. 5 (1910) Bot. 338; En. Philip. 1 (1922) 206. — **Fig. 13.**

Stems erect, 25–45 cm. Roots fibrous or slightly

thickened but not tuberous. *Leaves* 6–9, ovate to oblong, obtuse or subcuneate at the base, acuminate, 6–12½ by 2½–5 cm, with usually 7 veins prominent on the lower surface and numerous finer veins; petiole (3–)5–12 mm. *Flowers* in the axils of the lower leaves. *Pedicels* 1–2½ cm. *Perianth* seg-

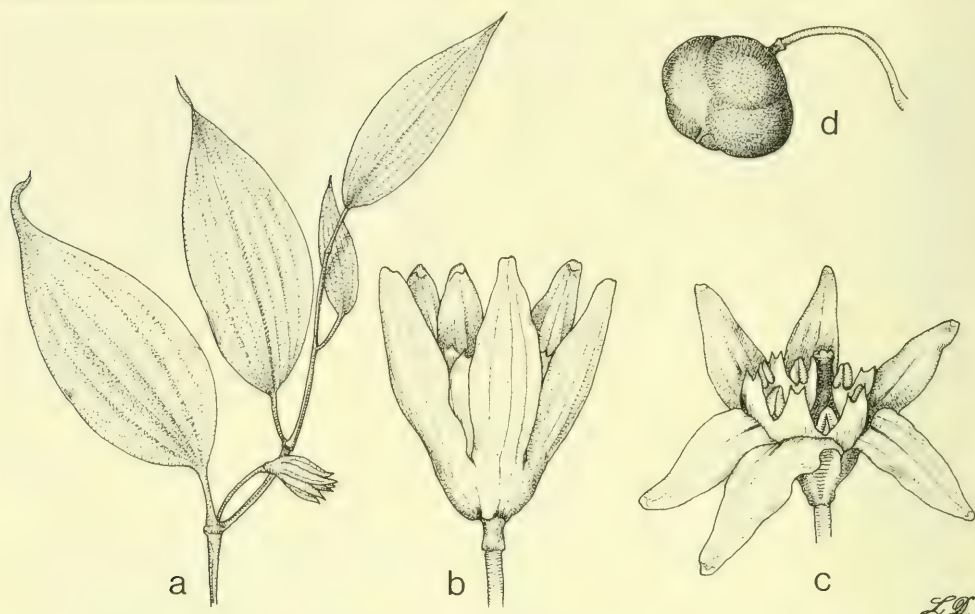


Fig. 13. *Disporopsis fusco-picta* HANCE. a. Habit,  $\times \frac{1}{2}$ , b. flower, c. ditto, laid open showing corona and stamens, both  $\times 2\frac{1}{2}$ , d. fruit,  $\times 2$  (a-c STEINER 2147, d PNH 7471).

ments fused below middle, 13–15 by 2–3 mm, lanceolate, obtuse, shallowly saccate at the base, white with (always?) dull purple inside. *Corona* attached close to perianth sinus, c. 4 mm long, its lobes emarginate. *Anthers* sessile on the corona, c. 1 mm long, very shallowly sagittate. *Berry* becoming purple, blue or black, c. 1 cm  $\varnothing$ . Seeds c. 4 mm  $\varnothing$ .

Distr. Southern China, Taiwan, in *Malesia*: Philippines (N. Luzon: Lepanto, Bontoc and Benguet Prov.).

Ecol. Mossy forest, 1700–2500 m, with one record of association with (the secondary pyrogenous savanna of) *Pinus insularis*. *Fl.* rarely recorded: May–June, or later.

## 16. TRICALISTRA

RIDL. J. Fed. Mal. St. Mus. 4 (1909) 83; Fl. Mal. Pen. 4 (1924) 330. — *Tupistra sensu* HUTCH. Fam. Fl. Pl. ed. 3 (1973) 749, in part. — **Fig. 14d.**

Stemless herbs. *Rhizome* horizontal, woody; roots thick and fleshy. *Leaves* large, basal, caespitose, petioled, expanding towards the base to form a sheath, with a strong main vein and numerous finer veins. *Inflorescence* a spike. Flowers numerous, each in the axil of a bract. *Perianth* segments 6, fleshy, fused for about half their length, campanulate, equal. *Stamens* 6, attached to the perianth; anthers subsessile, dorsifixed, oblong, dehiscing introrse-laterally. *Ovary* superior, sessile, subcylindrical, 3-lobed, 1-celled, containing (2 or) 4 discord ovules but with traces of two further carpels; stigmas 3, hippocrepiform, sessile. *Fruit* a drupe, green when unripe, globose, 1-seeded.

Distr. Monotypic. *Malesia*: Malay Peninsula.

Note. Regarded as a synonym of *Tupistra* by HUTCHINSON and recognized, but with some doubt, by AIRY SHAW (Willis Dict. ed. 8, 1973). The only consistent difference is that *Tricalistra* has no style, consistently 6 stamens, and a 3-lobed stigma, a set of characters of equal standing as those separating other genera in the *Aspidistreae*.



1. *Tricalistra ochracea* RIDL. J. Fed. Mal. St. Mus. 4 (1909) 83; Fl. Mal. Pen. 4 (1924) 331. — Fig. 14d.

Scale-like leaves several, sessile, lanceolate to 5 cm long. Foliage leaves few, broadly lanceolate to oblanceolate, acuminate, cuneate at the base; dark green, chartaceous, 30–40 cm long when in flower, lengthening in fruit, 8–11 cm broad; petiole poorly differentiated, sometimes winged, 12–20 cm. Inflorescence 12–15 cm long when in flower, lengthening in fruit, with 25–35 flowers. Bracts ovate, obtuse, caducous, to 3 mm long. Perianth fleshy, c. 5 mm long, lobes as long as the tube, recurved, ovate, acute, dull ochreous yellow.

Anthers united below the mouth of the perianth tube, thecae divaricate at base, less than 1 mm long. Ovary c. 3 mm long. Fruit to c. 2 cm long.

Distr. *Malesia*: Malay Peninsula (Pahang; Cameron Highlands).

Ecol. One collection annotated 'on rocks in open places', 1000 m. Fl. Nov. (one record), fr. April.

Note. Syntypes collected by RIDLEY (13692) are in SING and K. RIDLEY referred to the leaf having 6 veins. However, leaves on both type specimens have at least 100 of which about 13 are more conspicuous than the others. The only other collection (NUR SF 32725) agrees with the type.

## 17. TUPISTRA

KER-GAWL. Bot. Mag. 39 (1814) t. 1655; BL. Tijd. Nat. Gesch. Phys. 1 (1834) 67; BAKER, J. Linn. Soc. Bot. 14 (1875) 580; HOOK. f. Fl. Br. Ind. 6 (1892) 324; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 372. — Fig. 14a–c.

Stemless herbs. Rhizome tuberous or horizontal, thick and woody; roots thick and fleshy. Leaves large, basal, scattered or distichous, usually distinctly petioled, expanding towards the base to form a sheath, with a strong main vein and numerous finer veins. Inflorescence a spike. Flowers numerous, each in the axil of a bract. Perianth segments 6 or 8, fleshy, fused, campanulate, equal. Anthers sessile or subsessile, inserted in tube, dorsifixed, oblong or ovoid, introrse. Ovary superior, sessile, subglobose or not externally differentiated from style, 3(–4)-celled; ovules 2 in each locule; style cylindrical; stigma large, peltate or capitate, entire or variously lobed. Fruit a globose berry, usually 1-seeded; seeds turgid; perianth persisting below the fruit.

Distr. Eastern Himalayas to southern China; in *Malesia*: Malay Peninsula and Sumatra.

The type of *T. squalida* (the type species) was described, undoubtedly in error, from Amboina.

About 25 spp. have been described, but many of these should probably be reduced to synonymy.

Ecol. Most frequently recorded from dry evergreen forest, often in deep shade and often from near streams.

Syst. It appears to me that in the *Aspidistreae* too many small genera are distinguished on insignificant characters.

Note. The Malesian species have been insufficiently collected for convincing taxonomic judgements to be made.

### KEY TO THE SPECIES

1. Spike to 17 cm long; style and ovary up to 7 mm long; stigma usually  $1\frac{1}{2}$ –3 mm  $\varnothing$ . 1. *T. violacea*
1. Spike at least 20 cm long; style and ovary at least  $7\frac{1}{2}$  mm long; stigma at least  $4\frac{1}{2}$  mm  $\varnothing$  2. *T. grandis*

1. *Tupistra violacea* RIDL. J. Str. Br. R. As. Soc. n. 41 (1904) 35; Mat. Fl. Mal. Pen. Monoc. 2 (1907) 93; Fl. Mal. Pen. 4 (1924) 330.

Leaves few, elliptic to oblanceolate, acute or acuminate, cuneate at the base; lamina 50–70 by  $7\frac{1}{2}$ –13 cm; petiole well-defined, to 40 cm. Inflorescence ascending to 17 cm long when in flower, lengthening in fruit, with 30–40 flowers. Bracts somewhat amplexicaul ovate, c. 5 by 3–8 mm.

Perianth segments violet; the tube 5–6 mm long,  $4\frac{1}{2}$ –6 mm wide; lobes darker than tube, oblong to ovate, 4– $5\frac{1}{2}$  by 3–4 mm. Anthers sessile, attached in tube or throat, c. 1– $1\frac{1}{4}$  mm long. Style and ovary white, spotted violet,  $3\frac{1}{2}$ –7 mm long; stigma  $1\frac{1}{2}$ –4 mm  $\varnothing$ , obscurely lobed.

Distr. *Malesia*: Malay Peninsula (Perak; Bujong Malacca; Penang Highlands); probably also in Thailand.

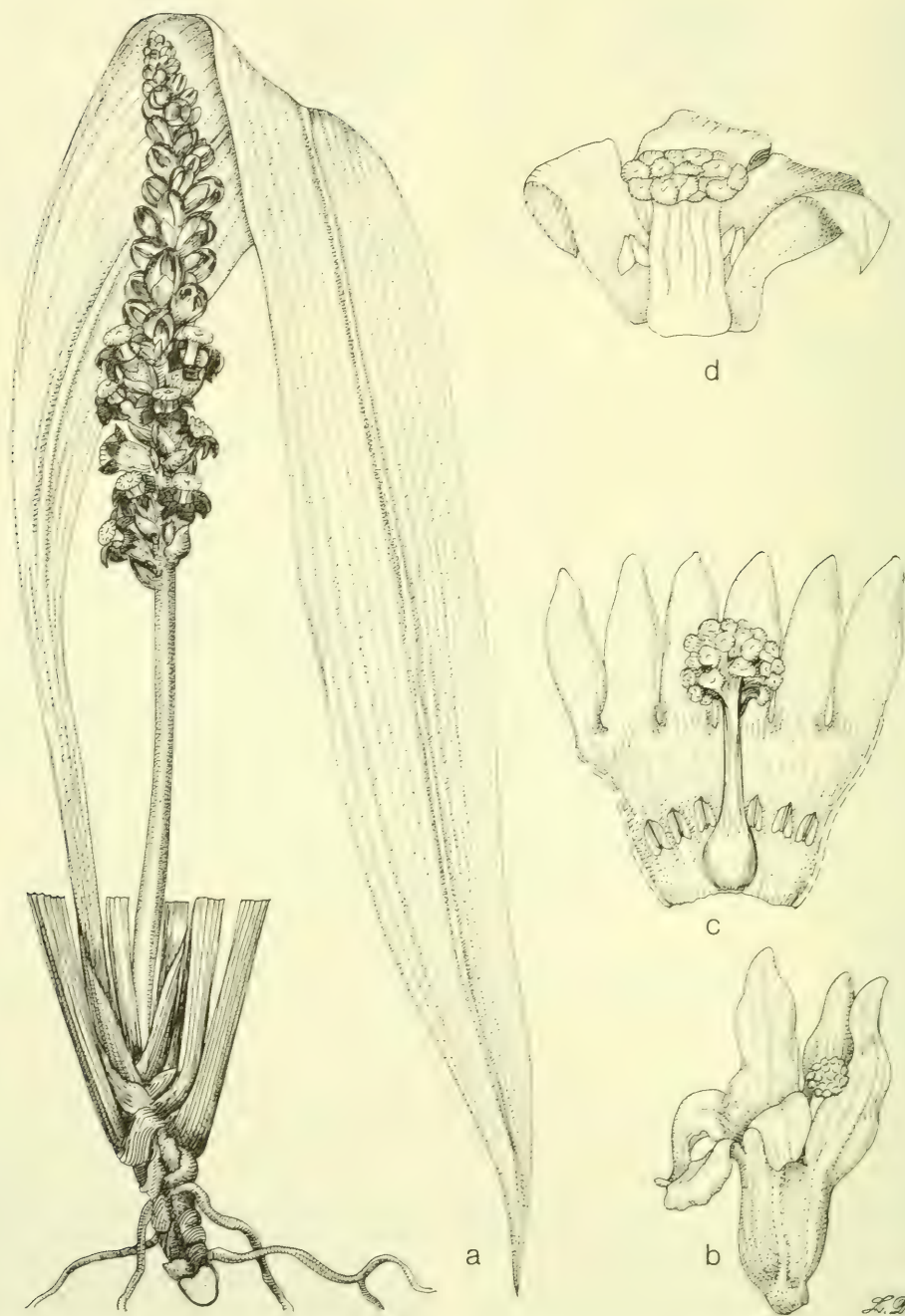


Fig. 14. *Tupistra grandis* RIDL. a. Habit,  $\times \frac{1}{2}$ , b. flower from outside, c. flower laid open, both  $\times 2$ . — *Tricalistra ochracea* RIDL. d. Flower, halved, showing gynoeceum, 3 tepals, to which stamens are attached,  $\times 10$  (a-c LÖRZING 8753, d RIDLEY 13692).



Ecol. Mountain forest, apparently rare and no collections made since 1901 have been seen. *Fl.* March, Dec.

Note. This species closely resembles *T. squalida*, the type species of the genus, from the Himalayas. Further study is needed to confirm that they should be kept separate. In the absence of recent collections much of the information here is taken from RIDLEY (1924). The scale-like leaves recorded for *T. gracilis* are likely to occur in *T. violacea*, but the basal part of the plant has not been preserved.

2. *Tupistra grandis* RIDL. *J. Bot.* (1900) 73; *Mat. Fl. Mal. Pen. Monoc.* 2 (1907) 93; *Fl. Mal. Pen.* 4 (1924) 330; B. M. ALLEN, *Mal. Nat. J.* 19 (1966) 303. — *T. perakensis* NICHOLS. *Ill. Dict. Gard., Cent. Suppl.* (1901) 722. — **Fig. 14a-c.**

Leaves few, surrounded by several sessile lanceolate scale-like leaves to 25(–40) cm long, elliptic or sublinear to oblanceolate, acute or acuminate, cuneate at the base; lamina (50–)70–150 by 6–14 cm; petiole often winged and poorly defined, to 40 cm. *Inflorescence* erect, 20–50 cm long when in flower, lengthening slightly in fruit, with up to 100 or more flowers, with a strong smell. Bracts somewhat amplexicaul, ovate, 5–10 by 2–6 mm. *Perianth* segments violet to dark purple; tube 5–11 mm long, 5–10 mm wide; lobes darker than tube, oblong to ovate, 4–14 by 3–5 mm. *Anthers* sessile, attached near top of tube, 1½–2 mm long. *Style* and *ovary* white, 7½–16 mm long; stigma 4½–12½ mm Ø, peltate, flat to biconvex, sometimes rugulose or irregularly lobed.

Distr. *Malesia*: Malay Peninsula (Perak, Kelantan, Pahang, Selangor, Langkawi) and N. Sumatra (Tapanuli Res.: Karo Highlands); probably also in Thailand.

Ecol. In Malaya records suggest that it usually occurs in wet rocky places on limestone. In Sumatra it grows in forest at 600–1225 m, but in

Malaya there is a record of 150 m in Perak. *Fl.* Jan.–Dec.

Vern. N. Sumatra: *singkut antu*, Karo-Batak.

Note. The Sumatran specimens tend to have longer spikes and larger flowers than the Malayan material. No characters have, however, been found on which to base taxonomic separation.

#### Excluded

*Tupistra singaporeana* [WALL. *Cat. n.* 5195]; BAKER, *J. Linn. Soc. Bot.* 14 (1875) 581; HOOK. *f. Fl. Br. Ind.* 6 (1892) 325, was omitted from the genus by S. KURZ (*J. As. Soc. Beng.* 44, ii, 1875, 199) and has indeed appeared not to belong to *Liliaceae*. It was referred by RIDLEY (*Mat. Fl. Mal. Pen. Monoc.* 1, 1907, 232) to *Neuwiedia curtisii* ROLFE and by ROLFE (*Kew Bull.* 1907, 412) to *Neuwiedia singaporeana* (BAKER) ROLFE.

According to DE VOGEL (*Blumea* 17, 1969, 331) = *Neuwiedia zollingeri* RCHB. *var. singaporeana* (BAKER) DE VOGEL (*Orchidaceae*).

*Tupistra squalida* KER-GAWL. *Bot. Mag.* 39 (1814) t. 1655; EDWARDS, *Bot. Reg.* (1823) t. 704; LODDIGES, *Bot. Cab.* 6 (1821) t. 515; BL. *Tijd. Nat. Gesch. Phys.* 1 (1834) 67, t. IIIC; MIQ. *Fl. Ind. Bat.* 3 (1859) 569; BAKER, *J. Linn. Soc. Bot.* 14 (1875) 580; *cf.* HOOK. *f. Fl. Br. Ind.* 6 (1892) 324, *in nota sub T. nutans*. — *Rhodea tupistra* SCHULT. *Syst.* 7, 2 (1829) 173, *nom. illeg.*

The provenance of this species, the type of the genus, was given as 'Amboyna'. This is certainly erroneous. It was described from a cultivated plant in the nurseries of LODDIGES, and was obviously in the former century cultivated in several botanic gardens. The more curious it is that its proper identity and native country remains more or less uncertain.

BAKER *l.c.* reduced *T. nutans* WALL. (*Bot. Reg.* t. 1333) from India to this species, but HOOKER *f.* kept these two entities apart.

### 18. LIRIOPE

LOUR. *Fl. Coch.* (1790) 200; L. H. BAILEY, *Gent. Herb.* 2 (1929) 3; KRAUSE in E. & P. *Nat. Pfl. Fam.* ed. 2, 15a (1930) 376; WANG & TANG, *Act. Phytotax.* 1 (1951) 331; HUME, *Baileya* 9 (1961) 135. — *Ophiopogon* (*non* KER-GAWL.) KUNTH, *En. Pl.* 5 (1850) 297, in part. — **Fig. 16d.**

Stemless or shortly caulescent, rhizomatous herbs. Roots thick, sometimes with tuberous swellings. *Leaves* usually basal, petioled or subpetioled linear to oblanceolate or lanceolate, many-nerved. *Inflorescence* a spike or raceme. Flowers solitary or fascicled in the axil of each bract. *Perianth* segments fleshy, campanulate, free or with a broad tube and short lobes, equal, with 1 vein, violet or white. *Anthers* 6–8, subsessile or pedicels short, attached near base of perianth, dorsifixed, introrse. *Ovary* superior, sessile, ovoid to subglobose, 3–4-celled; ovules axile, 2 in



Fig. 15. *Ophiopogon caulescens* (BL.) BACK. Habit, with seed,  $\times \frac{1}{4}$ . In forest above mountain garden Tjibodas, Febr. 1936.



each locule; style short and thick; stigma capitate or peltate. Ovary wall rupturing early in the growth of the seeds which are therefore exposed during most of their development. *Seeds* black, globose or slightly elongate, with fleshy testa; perianth persistent.

Distr. About 5  *spp.*, in Japan, China, Indo-China and *North Malesia*: N. Philippines.

Note. Some species are widely grown as ornamentals.

**1. *Liriope graminifolia*** (L.) BAKER, J. Linn. Soc. Bot. 17 (1879) 499; MERR. En. Philip. 1 (1922) 207; HUME, Baileya 9 (1961) 150. — *Asparagus graminifolius* LINNÉ, Sp. Pl. ed. 2 (1762) 450. — *Dracaena graminifolia* (L.) LINNÉ, Syst. Nat. ed. 12 (1767) 275. — ? *L. spicata* LOUR. Fl. Coch. (1790) 201; L. H. BAILEY, Gent. Herb. 2 (1929) 33; MERR. Comm. Lour. (1935) 109; HUME, Baileya 9 (1961) 150, 152, 158. — ? *Ophiopogon spicatus* (LOUR.) KER-GAWL. Bot. Reg. 7 (1821) t. 593; NAVES, Nov. App. (1880) 264. — *Mondo graminifolia* (L.) KOIDZ. Tokyo Bot. Mag. 40 (1926) 333. — *L. muscari* [non (DECNE) L. H. BAILEY] HATUS. Mem. Fac. Sc. Kagoshima Un. 5, 3 (1966) 62. — **Fig. 16d.**

Rhizome horizontal, slender, moderately woody. Roots bearing distant tubers. *Leaves* basal, caespitose, linear to narrowly linear-oblongate, minutely denticulate on the margins, the central vein sometimes conspicuously larger than the others, expanded to form membranous wings towards the base, 25–90 cm long, 2–9 mm broad. Peduncle erect, (12–)30–50 cm long, shorter than leaves. Bracts deltoid, to 4 mm long. *Pedicels*

2–5-nate, 2–12 mm long, articulated at the base of the flower. Leafy shoots occasionally produced from axil of bracts on inflorescence. *Perianth* segments free,  $3\frac{1}{2}$ –4 mm long, violet. *Filaments* to 2 mm long; anthers c. 1 mm long. *Seeds* oblong (perhaps only when young) or globose, c. 5 mm long.

Distr. Japan, China and *North Malesia*: Philippines (Batan Is.; Mindoro and Luzon).

The paucity of collections suggests that this species is rare in the Philippines.

Ecol. Open slopes at c. 1400 m (MERRILL, *l.c.*), but obviously in the Batan Is. at low altitude.

Notes. The differences between *L. graminifolia* and *L. spicata* are not clear. HUME depended for their separation largely on the conspicuous membranous basal wings to the leaves of the former, associated with quantitative characters of the leaves and inflorescence. *L. graminifolia* is likely to remain the correct name for the Philippine species whether *L. spicata* is treated as a synonym or not.

*L. muscari* (DECNE) L. H. BAILEY (Gent. Herb. 2, 1929, 35) differs according to HUME by caespitose habit and stiffer and wider leaves (8–26 mm).

## 19. OPHIOPOGON

KER-GAWL. Bot. Mag. 27 (1807) t. 1063; HOOK. f. Fl. Br. Ind. 6 (1892) 267; RIDL. Fl. Mal. Pen. 4 (1924) 326; RODRIGUEZ, Bull. Soc. Bot. Fr. 75 (1928) 997; Fl. Gén. I.-C. 6 (1934) 655; BACK. & BAKH. f. Fl. Java 3 (1968) 95, *nom. gen. cons.* — *Mondo* ADANS. Fam. 2 (1763) 496; FARWELL, Amer. Midland Nat. 7 (1921) 41; L. H. BAILEY, Gentes Herb. 2 (1929) 17; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 377; OHWI in Fedde, Rep. 36 (1934) 45. — *Flueggea* RICH. Neues J. Bot. 2 (1807) 8 (*'Fluggea'*); BAKER, J. Linn. Soc. Bot. 17 (1879) 500. — *Chloopsis* BL. En. Pl. Jav. (1827) 14; HASSK. Flora 34 (1851) 481. — **Fig. 15, 16a–c.**

Stemless herbs. *Rhizome* sometimes very short; roots fibrous or fleshy, sometimes tuberous. *Leaves* basal, linear or petioled with a broad lamina, expanded at the base to form a conspicuous scarious sheath. *Inflorescence* a raceme. *Pedicels* 1–several-nate, in the axils of bracts and usually associated with a few smaller bracts also apparently in the axil of the principal bract, articulated usually in the distal half. *Perianth* segments free, equal, with 1 vein, spreading or campanulate, white or violet. *Filaments* often connate, short, thick, glabrous, attached to the base of the perianth segments or to the receptacle; anthers basifixed, linear-oblong, dehiscing introrsely. *Ovary* superior to inferior, 3-celled; ovules basal, 2(–6) in each locule;

style columnar, minutely 3-lobed. Ovary wall rupturing early in the growth of the seeds which are therefore exposed during most of their development. *Seeds* blue, often globose, with fleshy testa; perianth often wholly or partly persistent.

Distr. India through to southern China to Thailand, Indo-China, Japan and Taiwan; in *Malesia*: Malay Peninsula, Sumatra, Java, Borneo, and Philippines.

About 70 *spp.* of *Ophiopogon* have been described, but I doubt whether more than a third of these should be recognized.

Ecol. In forest.

Notes. RIDLEY recognized *O. malayanus*, *O. intermedius* and *O. prolifera* from the Malay Peninsula. No fertile material has been seen from this area and the only specimens seen (CORNER SF 37872, K & L, and SOEPADMO & MAHOMUD 1214, K) do not differ significantly from *O. caulescens*.

No Malayan material identified as *O. intermedius* or *O. prolifera* has been seen.

RIDLEY characterized *O. prolifera* by having the filaments connate, and distinguished *O. intermedius* from *O. malayanus* on its larger flowers (12 mm wide). He did not give a comparable figure for *O. malayanus* but recorded that the segments were 3 mm long.

The descriptions could all be of varieties of *O. caulescens*, falling within the morphological range known for that species from Java, except that the shortest perianth recorded for Java material is 4 mm long (almost 50% greater than the length recorded for *O. malayanus*).

*O. malayanus* has also been recorded from the Philippines and Borneo (MERRILL, 1922).

Material from continental Asia of *O. intermedius* resembles *O. japonicus*, but no material has been seen from the Malay Peninsula.

#### KEY TO THE SPECIES

1. The broadest leaves on each plant more than 4 mm broad. Rhizome well-developed. Lowest bracts 12–25 mm long . . . . . **1. *O. caulescens***
1. The broadest leaves on each plant less than 3 mm broad. Rhizome poorly developed. Lowest bracts 5–10 mm long . . . . . **2. *O. japonicus***

**1. *Ophiopogon caulescens* (BL.) BACK.** Handb. Fl. Java 3 (1924) 74; VAN HELTEN, Med. Alg. Proefstation Landb. n. 16 (1924) 49 ('*gauliscens*'); RIDL. J. Bot. 43 (1925) Suppl. 122; DOCT. v. LEEUWEN, Verh. Kon. Ak. Wet. A'dam sect. II, 31 (1933) 252; BACK. & BAKH. f. Fl. Java 3 (1968) 95. — ? *O. intermedius* D. DON, Prod. Fl. Nep. (1825) 48; RIDL. J. Fed. Mal. St. Mus. 4 (1909) 81, incl. var. *macranthum* RIDL.; Fl. Mal. Pen. 4 (1924) 327. — *Chloopsis caulescens* BL. En. Pl. Jav. (1827) 14; ZOLL. Syst. Verz. 1 (1854) 67; MIQ. Fl. Ind. Bat. 3 (1859) 553. — *Chloopsis acaulis* BL. En. Pl. Jav. (1827) 14; MIQ. Fl. Ind. Bat. 3 (1859) 553. — ? *O. prolifera* LINDL. J. Hort. Soc. 1 (1846) 76; MIQ. Fl. Ind. Bat. 3 (1859) 568; RIDL. Mat. Fl. Mal. Pen. Monoc. 2 (1907) 91. — *Fluggea wallichiana* KUNTH, En. Pl. 5 (1850) 303. — *O. wallichianus* (KUNTH) HOOK. f. Fl. Br. Ind. 6 (1892) 268; RIDL. J. Fed. Mal. St. Mus. 8 (1917) 118. — *O. malayanus* RIDL. J. Str. Br. R. As. Soc. n. 41 (1904) 34; Mat. Fl. Mal. Pen. Monoc. 2 (1907) 91; MERR. En. Born. (1921) 115; En. Philip. 1 (1922) 207; Contr. Arn. Arb. 8 (1934) 19. — *Mondo malayanum* (RIDL.) FARWELL, Amer. Midland Nat. 7 (1921) 42. — *O. japonicus* (non (L. f.)) KER-GAWL. KOORD. Fl. Tjib. 1 (1922) 47. — *O. acaulis* (BL.) RIDL. J. Bot. 63 (1925) Suppl. 122. — Fig. 15, 16b.

Rhizome rather woody and well-developed, sometimes supported by several thick prop-roots; roots thick but not bearing tubers. *Leaves* numer-

ous, linear to linear-oblongate, often slightly arcuate, subacute or narrowly obtuse, often with a prominent midrib, glaucous (waxy), or with glaucous stripes, on the lower surface, (15–)25–55(–65) cm by 3–10(–22) mm. Peduncle flattened, 10–35(–46) cm long. *Flowers* 3–12,  $\pm$  secund. Lower bracts 12–25 mm long. *Pedicels* solitary or, less often, 2-nate, spreading or erect-spreading, articulated often near the centre, 3–8 mm. *Perianth* segments white or violet, oblong or ovate- or elliptic-oblong, usually obtuse, the inner often slightly smaller than the outer, free segments (5–)7–7 $\frac{1}{2}$  by 2–3 mm. *Anthers* (2–)4–5 $\frac{1}{2}$  mm long; filaments connate at the base, c.  $\frac{1}{2}$ –2 mm, up to 1 mm broad at the base. *Ovary* inferior or semi-inferior; style terete, linear-obconic, (4 $\frac{1}{2}$ –)5–7(–9) mm, simple or minutely trifid; ovules 2 per locule. *Seeds* up to 6, glossy blue, globose or slightly ovoid or ellipsoid, 4–8 mm long.

Distr. Continental SE. Asia and *West Malesia*: Malay Peninsula (also Langkawi), Sumatra, all over Java, Sabah (Kinabalu area), S. Philippines (Sulu Is.: Jolo).

Ecol. Generally a forest species reported from 'rain forest' and 'primary forest'. Also recorded from screes, (650–)1000–2000 m. Fl. Jan.–Dec. DOCTERS VAN LEEUWEN l.c. stated that self-pollination is the rule.

Vern. Java: *suket alank*, J; Sabah: *ryran*, Murut dial.



Note. If it is shown that *O. intermedius* is synonymous with *O. caulescens*, it will become the correct name.

2. *Ophiopogon japonicus* (L. f.) KER-GAWL. Bot. Mag. 27 (1807) t. 1063; MERR. Philip. J. Sc. 1 (1906) Suppl. 35; *ibid.* 5 (1910) Bot. 338; En. Philip. 1 (1923) 207; HUME, Bailey 9 (1961) 142. — *Convallaria japonica* LINNÉ f. Suppl. (1781) 204. — *Mondo japonicum* (L. f.) FARWELL, Amer. Midland Nat. 7 (1921) 42. — *O. merrillii* MASAM. Bull. Soc. Bot. Fr. 84 (1937) 90. — Fig. 16a.

Rhizome poorly developed; roots fibrous with distinct tubers usually less than  $1\frac{1}{2}$  cm long and 4 mm broad (not present in all herbarium material even where roots are well represented). Leaves numerous, linear, usually more or less straight, acute or subacute, usually minutely denticulate on vein and margin, usually with a distinct midrib, glaucous (waxy) on the lower surface, 18–60 cm by  $1\frac{1}{2}$ –3(– $3\frac{1}{2}$ ) mm. Peduncle (10–)12–35 cm. Lower

bracts 5–10 mm long. Pedicels solitary, spreading or erect-spreading, articulated near or below the middle,  $2\frac{1}{2}$ –3 mm. Perianth segments white or violet, oblong-elliptic or ovate, obtuse, the inner slightly smaller than the outer, free segments,  $3\frac{1}{2}$ –4 by 2–3 mm. Anthers 2– $2\frac{1}{2}$  mm long; filaments connate at the base, c.  $\frac{1}{4}$  mm long and up to  $\frac{1}{4}$  mm broad at the base. Ovary inferior or semi-inferior; style terete, sublinear, c. 3 mm, simple; ovules 2 per locule. Seeds up to 6, glossy blue, globose or slightly ellipsoid, c. 4 mm long.

Distr. Japan and North Malesia: Philippines (Luzon: Benguet Prov.; Mindanao: Mt Apo).

Ecol. Chiefly in mossy forest, rather common in the Mountain Province, 850–2400(–2900) m. Fl. May–July, fr. Dec.–Jan.

Vern. Philippines: *langigit*, Ig., *takaáu*, Bon., *uli-uli*, Bag.

Note. A commonly cultivated garden plant in Java and other places in Malesia, especially for lining borders, but never flowering in the lowland.

## 20. PELIOSANTHES

ANDR. Bot. Repos. 10 (1810) t. 605; HASSK. Tijd. Nat. Gesch. Phys. 10 (1843) 121 ('*Pilosanthes*'); BAKER, J. Linn. Soc. Bot. 17 (1879) 503; HOOK. f. Fl. Br. India 6 (1892) 265; RIDL. Fl. Mal. Pen. 4 (1924) 323; RODRIGUEZ, Fl. Gén. I.-C. 6 (1934) 668; JESSOP, Blumea 24 (1976) 141. — *Teta* ROXB. [Hort. Beng. 1814, 24, *nomen*] Fl. Ind. ed. Carey 2 (1832) 165. — *Bulbisperma* REINW. ex BL. Cat. (1823) 59, *nomen*. — *Bulbospermum* BL. En. Pl. Jav. (1827) 15. — *Lourya* BAILL. Bull. Soc. Linn. Paris 1 (1888) 743. — *Neolourya* RODRIGUEZ, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 96. — Fig. 16e–g.

Erect, stemless, perennial herbs. Rhizome usually very short and horizontal; roots thick. Leaves basal, usually distinctly petioled, the blade sublinear to ovate or obovate, many-nerved. Peduncles flattened, at least at the base, erect, usually solitary. Pedicels and inflorescence surrounded at the base by scarious scale-like leaves. Inflorescence a simple raceme. Pedicels articulated. Flowers 1–6-nate in the axils of each bract. Perianth segments fleshy, campanulate or subglobose, fused below, equal, 1-veined, white, green, blue, violet or purple. Anthers sessile, attached to a short annular tube (corona) arising from the perianth, introrse. Ovary superior to inferior, 3-celled; ovules basal, 2–5 in each locule; style simple, conical to cylindrical; stigma capitate or undifferentiated. Ovary wall rupturing early in the growth of the seeds which are therefore exposed during most of their development. Seeds blue, ellipsoid to pyriform, with fleshy testa; perianth often persistent.

Distr. Monotypic, widespread in continental SE. Asia, from the southern Deccan to NE. India and southern China, in West Malesia: Malay Peninsula, Sumatra, Java, Lesser Sunda Is. (Sumbawa) and Borneo.

Ecol. Usually in forest, from the lowland to the mountains.

Note. In the past far too many species were described. For an account of the taxonomic problems on specific delimitation, see JESSOP (1976).



Fig. 16. *Ophiopogon japonicus* (L. f.) KER-GAWL. a. Habit,  $\times 1/4$ . — *O. caulescens* (BL.) BACK. b. Flower,  $\times 2$ . — *Ophiopogon* sp. c. Mature seeds,  $\times 2$ . — *Liriope graminifolia* (L.) BAKER. d. Flower,  $\times 4$ . — *Peliosanthes tetra* ANDR. ssp. *humilis* (ANDR.) JESSOP. e. Habit,  $\times 1/2$ , f. flower, perianth shown reflexed to reveal corona,  $\times 3$ , g. LS of flower to show attachment of corona and position of ovary,  $\times 7$  (a, c SWINBURNE s.n. ex Hort. Adelaide, b after STEEN. Mt. Fl. Java pl. 28: 3b, d largely after E. & P. Nat. Pfl. Fam. ed. 2, 15a, fig. 153 '*O. spicata*', e-g SØRENSEN c.s. 2960).

1. *Peliosanthes tetra* ANDR. Bot. Repos. 10 (1810) t. 605; BAKER, J. LINN. Soc. Bot. 17 (1879) 505; HOOK. f. Fl. Br. Ind. 6 (1892) 265; RIDL. Mat. Fl. Mal. Pen. Monoc. 2 (1907) 88; Fl. Mal. Pen. 4 (1924) 323; RODRIGUEZ, Fl. Gén. I.-C. 6 (1934) 669; JESSOP, Blumea 24 (1976) 154.

For synonyms see under the subspecies.

Leaves (2-)4-8(-12); leaf-blades ( $7\frac{1}{2}$ -)12 $\frac{1}{2}$ -47 $\frac{1}{2}$  by  $1\frac{1}{2}$ -8 $\frac{1}{2}$ (-11 $\frac{1}{2}$ ) cm; petioles (4-)7 $\frac{1}{2}$ -50 cm long, slightly compressed. Peduncles to 35(-75) cm high; lower sterile bracts 0-4(-15), to 15(-40) mm long; fertile bracts to 15(-30) mm long, smaller towards the apex of the raceme. Flowers 1-6-nate. Pedicels 1-6(-10) mm long, enlarging after flowering; articulation usually close to flower. Perianth segments suborbicular to linear,  $1\frac{1}{2}$ -6(-8) mm long. Corona forming a disk c. 3-4 mm  $\varnothing$ , entire or 6-toothed. Anthers usually rather closely adpressed to the style, c.  $\frac{1}{2}$ -2 mm long. Ovary most frequently semi-inferior; style often 3- or

6-ridged or fluted,  $\frac{3}{4}$ -1(-2) mm long. Seeds up to 10-12 mm long.

Distr. Tropical SE. Asia; in *Malesia*: Malay Peninsula, Sumatra, Java, Lesser Sunda Is. (Sumbawa), Borneo.

Ecol. Primarily in wet evergreen forest, from 0-3000 m above sea-level. A few records indicate that dry areas are also occasionally occupied, possibly in wet enclaves. The subspecies appear to grow in similar habitats.

Note. Grown as a garden ornamental or pot plant.

a. ssp. *teta*. — Cf. JESSOP, Blumea 24 (1976) 155. — *Teta viridiflora* ROXB. Fl. Ind. ed. Carey 2 (1832) 165. — *P. tetra* var. *mantegazziana* PAMP. Nuovo Giorn. Bot. Ital. n.s. 11 (1904) 151; Bull. R. Soc. Toscanaortic. III, 10 (1905) 50, f. 11. — *P. mantegazziana* (PAMP.) PAMP. Nuovo Giorn. Bot. Ital. n.s. 13 (1906) 138; MERR. & QUIS. Philip. J. Sc. 82



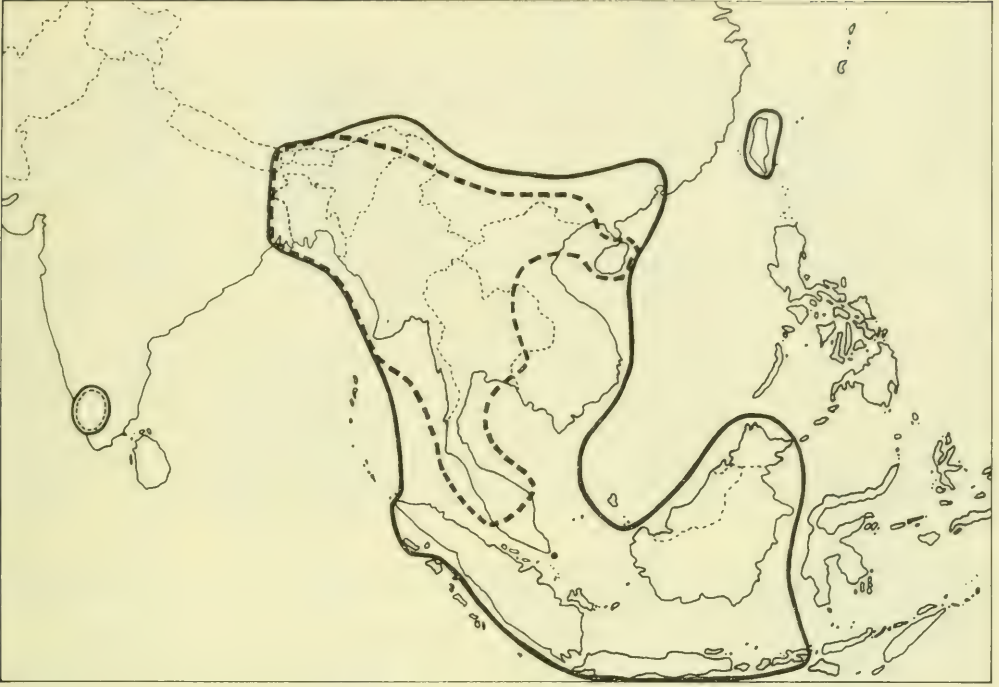


Fig. 17. Range of *Peliosanthes teta* ANDR. *ssp. teta* (broken line), and *ssp. humilis* (ANDR.) JESSOP (even line).

(1953) 323. — *P. graminea* RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 207. — *P. teta* var. *angustifolia* RIDL. l.c. — *P. tonkinensis* WANG & TANG, Bull. Fan Mem. Inst. Biol. Peiping, Bot. 7 (1936) 83.

Pedicels 2–6-nate. Leaf index 2–24(–34). Flowers usually green, rarely blue. Anthers c. 0.5–0.6 mm long.

Distr. India to southern China; in *Malesia*: Malay Peninsula (Pahang, Selangor, Penang and Langkawi Is.). Fig. 17.

**b. *ssp. humilis* (ANDR.) JESSOP**, Blumea 24 (1976) 155. — *P. humilis* ANDR. Bot. Repos. 10 (1811) t. 634; MIQ. Fl. Ind. Bat. 3 (1859) 568. — *Bulbisperma ovigera* REINW. ex BL. Cat. (1823) 59, nomen. — *Bulbospermum javanicum* BL. En. Pl. Jav. (1827) 15; ZOLL. Syst. Verz. 1 (1854) 68. — *P. javanica* (BL.) DIETR. Syn. Pl. 2 (1840) 1123; HASSK. Tijds. Nat. Gesch. Phys. 10 (1843) 121; Pl. Jav. Rar. (1848) 116; MIQ. Fl. Ind. Bat. 3 (1859) 568; BACK. Handb. Fl. Java 3 (1924) 75; BACK. & BAKH. f. Fl. Java 3 (1968) 95; STEEN. Mt. Fl. Java (1972) t. 28–4. — *P. violacea* WALL. ex BAKER, J. Linn. Soc. Bot. 17 (1879) 504; HEND. Mal. Wild Flow. Monoc. (1954) 184, f. 108. —

*Lourya campanulata* BAILL. Bull. Soc. Linn. Paris 1 (1888) 743. — *P. albida* BAKER, Bot. Mag. 116 (1890) t. 7110; HOOK. f. Fl. Br. Ind. 6 (1892) 267; RIDL. Mat. Fl. Mal. Pen. Monoc. 2 (1907) 90; MERR. En. Born. (1921) 115; FISCHER, Kew Bull. (1932) 183. — *P. viridis* RIDL. J. Str. Br. R. As. Soc. n. 31 (1898) 95. — *P. lurida* RIDL. l.c. 95. — *P. grandifolia* RIDL. l.c. 97. — *P. stellaris* RIDL. l.c. 97. — *P. parviflora* RIDL. *ibid.* n. 61 (1912) 61. — *P. sumatrensis* RIDL. J. Fed. Mal. St. Mus. 8 (1917) 118. — *P. sessiliflora* RIDL. l.c. 118. — *P. hypogyna* RIDL. *ibid.* 10 (1920) 121. — *P. monticola* RIDL. l.c. 155. — *P. campanulata* (BAILL.) RODRIGUEZ, Bull. Mus. Hist. Paris II, 6 (1934) 96. — **Fig. 16e–g.**

Pedicels solitary in the axil of each bract. Leaf index 2–10. Flowers sometimes green, but often white, blue, violet or purple. Anthers c.  $\frac{1}{2}$ –2 mm long.

Distr. India to southern China; in *Malesia*: Malay Peninsula (throughout, incl. the Langkawi, Penang, Singapore and Tioman Is.), Sumatra (throughout, incl. Simalur and Billiton Is.), Java (throughout), Lesser Sunda Is. (Sumbawa) and Borneo (Sarawak, Southeast, Sabah, incl. the Anambas and Karimata Is.). Fig. 17.

## 21. ALETRIS

LINNÉ, Sp. Pl. (1753) 319; Gen. Pl. ed. 5 (1754) 149; Amoen. Acad. 3 (1756) 11 ('*Alethris*'); HOOK. f. Fl. Br. Ind. 6 (1892) 264; FRANCHET in Morot, J. de Bot. 10 (1896) 178, 195; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 378; HARA, J. Jap. Bot. 42 (1967) 312. — *Metanarthecium* MAXIM. Bull. Ac. St. Pétersb. 11 (1867) 438; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 260. — *Meta-aletris* MASAM. Trans. Nat. Hist. Soc. Formosa 28 (1938) 46. — **Fig. 18, 19.**

Erect, stemless, rhizomatous herbs. Roots fibrous. *Leaves* basal, linear or lanceolate, sessile, the veins of the decayed bases persisting as fibres at the base of the plant. *Inflorescence* a raceme or spike. Flowers solitary in the axils of the bracts, with a single bracteole. *Pedicels* not articulated. *Perianth* segments connate at the base, equal, with three (often indistinct) veins, ascending or reflexing, glabrous or pubescent, white or pink. *Filaments* subulate, shorter than and attached to perianth; anthers dorsifixed, oblong to ovoid, dehiscent introrsely. *Ovary* half-inferior, 3-celled; ovules axile, numerous; style simple or minutely 3-lobed. *Fruit* a capsule; perianth persistent. Seeds oblong.

Distr. North America (few spp.) and eastern Asia, from Japan to southern China (also Taiwan) and the Himalayas, in *Malesia*: only on the high mountains of the Philippines (N. Luzon), Sabah (Mt Kinabalu) and N. Sumatra (Gajolands and Westcoast Res.).

There are possibly fewer than 15 spp., mostly in Asia, but HARA *l.c.* estimates the number at c. 30.

Ecol. Elfin forest and mossy mountain forest, but mostly in open, sometimes damp situations in sedge- or grasslands, crevices of rocks, and mountain heaths, locally often common, between (1000–)1600 and 3250 m.

## KEY TO THE SPECIES

1. Perianth glabrous. Leaves mostly spreading, usually at least 4 mm broad . . . . . 1. *A. foliolosa*  
 1. Perianth glandular-pubescent. Leaves usually erect, less than 4 mm broad . . . . . 2. *A. spicata*

1. *Aletris foliolosa* STAFF, Trans. Linn. Soc. II, 4 (1894) 240; DOCT. v. LEEUWEN, Trop. Natuur 9 (1920) 98, fig.; MERR. En. Born. (1921) 115; DOCT. v. LEEUWEN, Verh. Kon. Ak. Wet. A'dam sect. II, 31 (1933) 251, f. 66 ('*foliosa*'). — *A. rigida* STAFF, Trans. Linn. Soc. II, 4 (1894) 241; GIBBS, J. Linn. Soc. Bot. 42 (1914) 164; MERR. En. Born. (1921) 115. — ? *Liriope brachyphylla* MERR. Philip. J. Sc. 2 (1907) Bot. 266; En. Philip. 1 (1922) 206. — ? *Metanarthecium brachyphyllum* (MERR.) MASAM. Bull. Soc. Bot. Fr. 84 (1937) 18. — *A. sumatrana* MASAM. *l.c.* 18. — *Meta-aletris sumatrana* (MASAM.) MASAM. Trans. Nat. Hist. Soc. Formosa 28 (1938) 46. — *Meta-aletris rigida* (STAFF) MASAM. *l.c.* 46. — **Fig. 18a–d, 19.**

Leaves glabrous, ascending at first but usually spreading when mature and finally recurved, to 6–(10) cm by 4–7–(10) mm; veins several, close to one another. Peduncles 1 or more, 6–65 cm high, glabrous, rigid, with 1–6 narrow-lanceolate, sterile bracts to 2 cm long; fertile bracts 4–20, lanceolate, 5–10 mm long; bracteoles similar to bracts but shorter. *Pedicels* 0–5 mm long in flower, sometimes over 1 cm in fruit, usually expanding gradually to

the ovary. *Perianth* segments white, pink, yellow or brownish, glabrous, shortly connate, arising near the middle of the ovary, oblong, obtuse,  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm by c.  $\frac{1}{2}$ – $\frac{3}{4}$  mm. *Anthers* yellow to red,  $\frac{1}{2}$ –1 mm long; filaments arising c.  $\frac{1}{2}$  mm from base of perianth, the base conspicuously decurrent,  $1\frac{1}{2}$ –2 mm long. *Ovary* 3-lobed, 2– $2\frac{1}{2}$  mm long, ellipsoid or obovoid; style 1– $1\frac{1}{2}$  mm, simple or minutely 3-lobed, caducous. *Capsule* ellipsoid or ovoid, to 7 mm long.

Distr. *Malesia*: Sabah (Mt Kinabalu) and North Sumatra (Gajolands and some volcanoes of the Westcoast Res., especially Mt Singalang), possibly also in the Philippines (Mindoro: Mt Halcon).

STAFF's (1894) record from Malaya seems to be erroneous.

Ecol. Elfin and mossy forest, but mostly in the open mountain heath, both on stony ground and in boggy places, between moss-cushions, 2000–3450 m. *Fl.* (Jan.–)March–Sept.–(Dec.).

In West Sumatra DOCTERS VAN LEEUWEN *l.c.* observed that the flowers are proterogynous and self-pollination is the rule, all flowers setting fruit.





Fig. 18. *Aletris foliolosa* STAFF. *a.* Habit,  $\times \frac{1}{2}$ , *b.* flower,  $\times 5$ , *c.* tepal with stamen,  $\times 10$ , *d.* dehiscent fruit,  $\times 4$ . — *A. spicata* (THUNB.) FRANCH. *e.* Habit,  $\times \frac{1}{4}$ , *f.* flower,  $\times 7\frac{1}{2}$ , *g.* fruit,  $\times 7\frac{1}{2}$  (*a-d* SCHIFFNER 1700, *e* CLEMENS 9178, *f-g* JACOBS 7426).

Notes. *A. foliolosa* and *A. rigida* were both originally described from Borneo, differing principally in size, but, as pointed out by several collectors in field notes (*e.g.* SINCLAIR and SLEUMER), the range of intermediates is such that the characters STAFF used to separate them break down. The smaller form tends to occur at higher altitudes (above 2700 m) and does not occur in Sumatra.

Plants from Sumatra often differ from those from Borneo in having longer pedicels, but this character is too variable to be of taxonomic significance.

*Liriope brachyphylla* MERR. is known only from the type collection from Mt Halcon in Mindoro (Philippines: MERRILL 5710). This collection falls within the above description of *A. foliolosa*, being



Fig. 19. *Aletris foliolosa* STAPF. In low vegetation on old lavas; Sumatra Westcoast Res., Mt Singalang, c. 2800 m altitude (W. MEIJER, 1956).

somewhat atypical in that the leaves appear softer and the flowers fewer (up to 7 per inflorescence) than usual. Further material is needed to decide on the identity of the Philippine material with certainty.

2. *Aletris spicata* (THUNB.) FRANCH. in Morot, J. de Bot. 10 (1896) 199; MERR. Philip. J. Sc. 1 (1906) Suppl. 182; *ibid.* 5 (1910) Bot. 338; En. Philip. 1 (1922) 207. — *Hypoxis spicata* THUNB. Fl. Jap. (1784) 136. — *A. japonica* LAMBERT, Trans. Linn. Soc. 10 (1811) 407, *non* THUNB. — Fig. 18e–g.

Leaves glabrous, usually erect, thinner than in *A. foliolosa*, usually 7–20 cm by 1–3 mm; veins 3, well-spaced. Peduncles 25–60 cm, glandular pubescent at least in the upper part, rigid, with 6–15 narrow-lanceolate sterile bracts to 5 cm long; fertile bracts 30–70, lanceolate, 3–8 mm long; bracteoles similar to the bracts but shorter; pedicels 0–1 mm, not greatly elongating in fruit, rather abruptly expanding to the base of the ovary. Perianth segments white, sometimes pink towards the tip, glandular pubescent, connate to one-third of their length, arising near the apex of the ovary, oblong, subacute,  $2\frac{1}{2}$ –3 by c. 1 mm. Anthers orange, to c.  $\frac{1}{2}$  mm long, subsessile, attached near middle of perianth. Ovary c. 2 mm long, oblong to obovoid; style c. 1 mm, minutely 3-lobed. Capsule obovoid, 5 mm long.

Distr. Japan, southern China, Taiwan and N. Malesia: Philippines (N. Luzon: Abra, Benguet and Bontoc Prov.).

Ecol. Among grasses above (1000–)1600–2300 m, usually in pine forest, but often in open places. Fl. Jan.–Dec.

Vern. Philippines: *salenganga*, Ig.

## 22. ASTELIA

BANKS & SOLAND. *ex* R. BR. Prod. (1810) 291, *nom. gen. cons.*; BTH. Fl. Austr. 7 (1878) 11; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 360; SKOTTSB. Kongl. Svenska Vet. Ak. Handl. III, 14, 2 (1934) 1–106; VAN BALGOOY, Pac. Pl. Areas 2 (1966) 86, map 47; MOORE & EDGAR, Fl. New Zeal. 2 (1970) 27–38. — *Funckia* WILLD. Mag. Ges. Naturf. Fr. Berlin 2 (1808) 19, *nom. rejic.* — Fig. 20.

Stemless or short-stemmed, dioecious herbs. Rhizome usually well-developed; roots fibrous. Leaves rosulate, 3-ranked, linear to lanceolate, forming a closed sheath at the base. Inflorescence a panicle; peduncles 3-angled. Pedicels solitary in the axils of bracts, not articulated. Perianth segments connate, 1- or 3-nerved, erect, spreading or reflexed, the outer often larger than the inner. Filaments filiform or somewhat flattened, attached to the perianth segments; anthers dorsifixed, ovoid, introrse. Ovary superior, sessile, depressed-globose to ellipsoid, 1- or 3-celled; ovules few to numerous, axile or parietal; style thick or absent. Fruit a berry; perianth persistent. Seeds ovoid or angled, glossy.



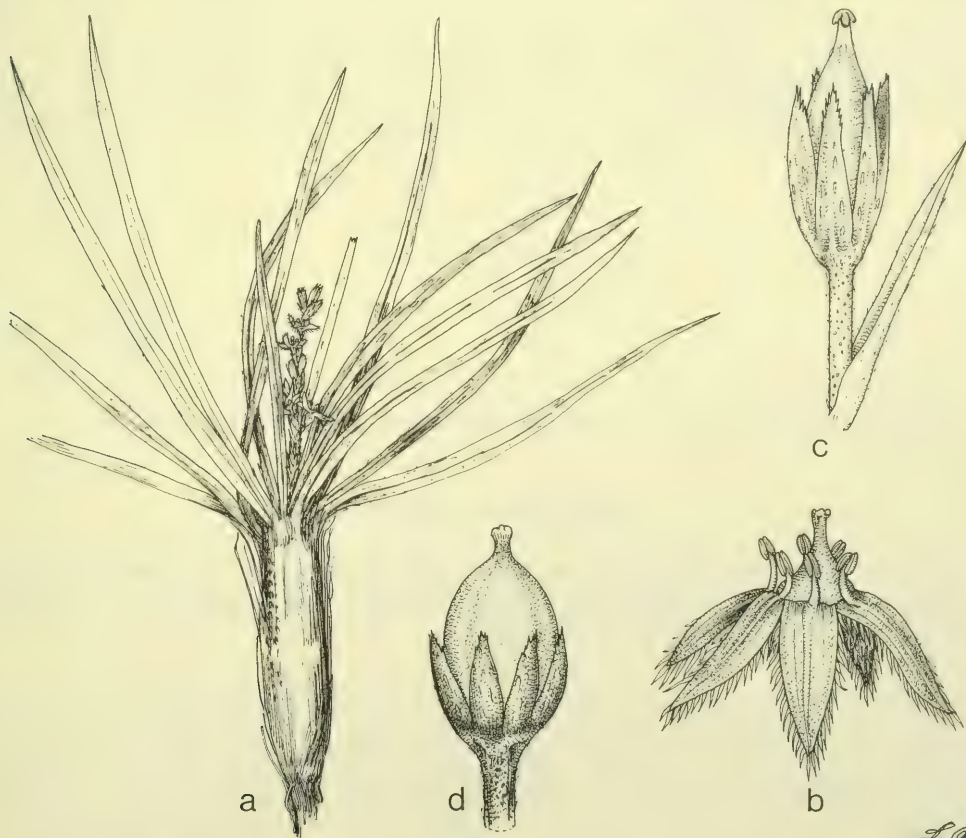
Distr. About 20–30 spp. in the Pacific (13 in New Zealand) including Australia (Victoria, New South Wales and Tasmania), Mauritius and the Falkland Is.; in *E. Malesia*: New Guinea.

Ecol. Some species are epiphytic in forests; others grow on the ground or on rocks, usually in wet areas. Several occur in bogs and may contribute to peat formation. They are to be found from sea-level in the south but only at alpine altitudes near the equator.

1. *Astelia alpina* R. Br. Prod. (1810) 291; BTH. Fl. Austr. 7 (1878) 11; F.v.M. Trans. R. Soc. Vict. 1, 2 (1889) 35; BURKILL, Kew Bull. (1899) 113; RODWAY, Tasm. Fl. (1903) 212; LAUT. Bot. Jahrb. 50 (1913) 298; KRAUSE, Bot. Jahrb. 59 (1925) 559; SKOTTSB. Kongl. Svenska Vet. Ak. Handl. III, 14, 2 (1934) 26. — *A. papuana* SKOTTSB. l.c. 29, incl. f. *minor* SKOTTSB. l.c. 30; HOOGL. Blumea Suppl. 4 (1958) 235. — Fig. 20.

Erect herb, forming dense cushions. Leaves linear to narrowly lanceolate, often with a silvery film on the upper surface and densely covered by silvery scales on the lower surface or glabrescent, often with red margins, 3–13(–40) cm by 3–7 (–25) mm, with 1–3 major veins and several minor;

leaf bases persistent and forming a silvery sheath round the rhizome. — ♂ *Panicle* densely covered by silvery scales, 2–8 cm long, with up to 3 simple branches subtended by bracts to 4(–12) cm long. Pedicels 3–6(–15) mm. Perianth segments green, pale yellow or brown, spreading or reflexed,  $2\frac{1}{2}$ –4 mm long, scaly on the outer surface. Filaments  $\frac{3}{4}$ – $1\frac{1}{2}$  mm; anthers c.  $\frac{1}{2}$  mm long. Gynoecium sterile, green,  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm long. — ♀ *Panicle* similar to the male but shorter, 1–5 cm long, bracts to 3(–7) cm long. Pedicels 2–4(–10) mm. Perianth segments green, pale yellow or brown, erect, 6– $7\frac{1}{2}$ (–9) mm long, glabrescent on the outer surface. Staminodes  $\frac{3}{4}$ – $1\frac{1}{4}$  mm long. Gynoecium c. 6 mm long, ovoid; style not differentiated from



L.G.

Fig. 20. *Astelia alpina* R. Br. a. Habit, ♂ plant,  $\times \frac{1}{2}$ , b. ♂ flower,  $\times 5$ , c. ♀ flower,  $\times 2\frac{1}{2}$ , d. fruit,  $\times 2$  (a–b BRASS 10332, c HOOGLAND & PULLEN 5782, d BRASS 10217).

ovary. Berry green, becoming bright red when ripe, ovoid or ellipsoid, c. 8–13 mm long. Seeds numerous, c. 2 mm  $\varnothing$ .

Distr. Australia (Tasmania, Victoria, southern New South Wales) and *E. Malesia*: New Guinea (from Mt Wilhelmina in W through the highlands of Papua New Guinea to Mt Albert Edward in E).

Ecol. Alpine and subalpine grasslands forming tussocks to large solid cushions in bogs, sometimes forming almost pure communities in very wet areas (e.g. in Pindaunde Valley), 3225–4500 m. Fig. 21.

Vern. Papua New Guinea: *maunz*, Habi'inz dial., *pangjubank*, Enga lang., *pogwe*, *tudik*, Mendi lang., *waiamaia*, Chimbu, *whyameya*, Kundiawa Subdistr.

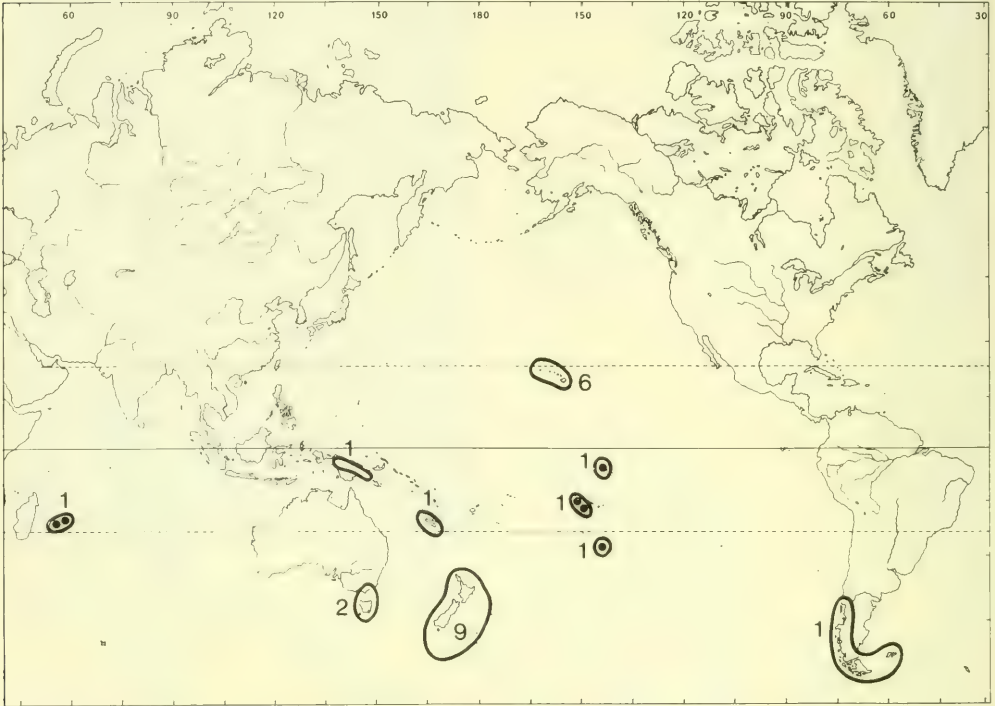


Fig. 21. Range of the genus *Astelia* (after VAN BALGOOY, in Pac. Pl. Areas 2, 1966, 87).

### 23. NOTHOSCORDUM

KUNTH, En. Pl. 4 (1843) 457, *nom. gen. cons.*; KRAUSE in E. & P. Nat. Pfl. Fam. ed. 2, 15a (1930) 322; BACK. Handb. Fl. Java 3 (1924) 61; TRAUB, Plant Life 10 (1954) 123; BACK. & BAKH. f. Fl. Java 3 (1968) 132.

1. *Nothoscordum inodorum* (W. AIT.) G. NICHOLS. Ill. Dict. Gard. 2 (1885–89) 457; A. & G. Syn. Mitt. Eur. Fl. 3 (1905) 167; BACK. Handb. Fl. Java 3 (1924) 62; BACK. & SLOOT. Handb. Theconkr. (1924) 89, fig.; TRAUB, Plant Life 10 (1954) 127; BACK. & BAKH. f. Fl. Java 3 (1968) 132. — *Allium inodorum* W. AIT. Hort. Kew. 1 (1789) 427. — *Allium fragrans* VENT. Jard. Cels. (1800) t. 26. — *N. fragrans* KUNTH, En. Pl. 4 (1843) 461.

Erect, inodorous, glabrous herb with a subterranean coated bulb. Leaves radical, linear, flat, somewhat glaucous, shorter than the peduncle, 15–45 by  $\frac{1}{2}$ – $1\frac{1}{4}$  cm. Umbels borne on an erect, 20–70 cm long peduncle, 6–17-flowered. Flowers fragrant. Pedicels  $1\frac{1}{2}$ –5 cm. Tepals basally shortly connate and green, 1– $1\frac{1}{4}$  cm, persistent, the segments oblong, 1-nerved, white, whether or not with a purple median streak. Stamens 6, inserted



on the base of the perianth; filaments ligulate with a subulate top; anthers medifixed. *Ovary* oblong-obovoid, sessile, 3-celled, each cell with ~ ovules; style filiform; stigma small. *Capsule* obovoid, membranous, loculicidally 3-valved, 8–9 mm long. Seeds several, black, often containing more than 1 embryo.

Distr. Native of subtropical North America, often cultivated and naturalized (e.g. in the

Mediterranean), in Java sometimes cultivated as an ornamental, escaped from the Tjibodas Botanic Garden in West Java on Mt Gedeh.

Ecol. Locally naturalized, in W. Java (Priangan) sometimes occurring in great numbers in fields, tea-estates, and along roadsides; 1000–1500 m. *Fl.* Jan.–Dec. Easily propagating by bulbils and seed, difficult to eradicate.

Vern. Java: *babawangan*, S.

#### Excluded

*Astelia novoguineensis* KRAUSE, Bot. Jahrb. 59 (1925) 559 is according to SKOTTSBERG (Bot. Jahrb. 65, 1932, 260) = *Helmholtzia novoguineensis* (KRAUSE) SKOTTSB. (*Philydraceae*).

*Laxmannia sessiliflora* DECNE, Herb. Timor. Descr. (1835) 35, t. 16; SPAN. Linnaea 15 (1841) 477; MIQ. Fl. Ind. Bat. 3 (1859) 66; BTH. Fl. Austr. 7 (1878) 66. This was said by MIQUEL to occur both in West Australia and Timor, but the latter addition is a slip of the pen. Cf. STEEN. Bull. Jard. Bot. Btzg III, 17 (1948) 463.

*Veratrum malayanum* JACK, Mal. Misc. 1 (1820) 25; in Hook. Bot. Misc. 2 (1831) 74. — *Veratrontia malayana* (JACK) MIQ. Fl. Ind. Bat. 3 (1859) 553 is, according to KURZ (Flora 56, 1873, 224) and MERRILL (cf. Fl. Males. I, 4, 1951, 249) = *Hanguana malayana* (JACK) MERR. (*Flagellariaceae*).

*Xerotes arenaria* R. BR. and *X. longifolia* R. BR. were cited by MIQUEL (Fl. Ind. Bat. 3, 1859, 248) to occur in Java, obviously both based on specimens collected by ZOLLINGER on Mt Salak, in West Java. Cf. ZOLLINGER, Syst. Verz. 1 (1854) 66. According to KURZ (Flora 56, 1873, 224) these are misidentifications for *Hypolytrum*, assumedly *H. nemorum* (VAHL) SPRENG. (*Cyperaceae*).





## DIPTEROCARPACEAE

(P. S. Ashton, Arnold Arboretum, Harvard University)<sup>1</sup>

Small or large *resinous* usually evergreen *trees*, usually buttressed, and often (if large trees) with flaky or fissured bark. Some or most parts with a *tomentum* of fascicled hairs, or sometimes single hairs, unicellular or multicellular glandular hairs, or multicellular, short or long lobed or peltate hairs. *Leaves* alternate, simple, margin entire or sinuate, not crenate, terminating  $\pm$  abruptly at the  $\pm$  prominent geniculate petiole, penninerved (in *Dryobalanops* and some *Hopea* nerves  $\infty$ , dense and slender), often with domatia in axils between nerves and midrib or along midrib and (rarely) nerves; tertiary nerves scalariform or reticulate. *Stipules* paired, large or small, persistent or fugaceous, leaving small to amplexicaul scars. *Inflorescence* paniculate, racemose, rarely cymose,  $\pm$  regularly, rarely irregularly, branched, terminal or axillary; *bracts* and *bracteoles* paired, small or large, persistent or fugaceous. *Flowers* secund or distichous, bisexual, actinomorphic, scented, nodding. *Calyx* persistent, 5-merous; 2–5 sepals usually greatly enlarging into wing-like lobes in fruit; sepals either free to base, imbricate in bud, remaining so or becoming valvate in fruit, or fused at base, forming a cup or tube  $\pm$  enclosing the fruit, adnate to or free from it. *Corolla* 5-merous, contorted, base connate or free, usually partially or entirely unicellular hairy. *Stamens* 5–110, 1–3 verticillate or irregular, hypogynous or subperigynous, centrifugal; filaments compressed or filiform, free or connate, frequently cohering with petals on falling; anthers erect, 2-celled with (2–)4 pollen sacs, introrse or laterally dehiscent; tapetal cells binucleate, pollen grains 2-celled at anthesis; connective with short or prominent appendage. *Ovary* superior or semi-inferior, 3-, rarely 2-, locular; style  $\pm$  thickened at base into a stylopodium, entire or trifid towards apex; stigma obscure or prominent, 3- or 6-lobed. Ovules 2(–3) in each loculus, axile, pendulous or laterally anatropous, bitegmatic with ventral raphe and superior micropyle. *Fruit* indehiscent, 1-seeded; with woody pericarp and persistent  $\pm$  aliform sepals. Embryo-sac development of *Polygonum* type; endosperm of the nuclear type, embryo development normal, ripe seeds with or more usually without endosperm; cotyledons equal or more usually unequal and with one more or less enclosing the other, laminar or fleshy, entire or lobed, enclosing the radical. Germination epigeal or hypogeal; pericarp splitting irregularly or along 3 sutures.

**Distribution.** The newly described monotypic genus *Pakaraimaea* MAGUIRE & ASHTON (1977), locally found in the south of former British Guyana, makes the family pantropical, confined to the lowlands and hills of the tropics below 1800 m. Fig. 2. This genus represents a distinct subfamily *Pakaraimoideae*.

The second subfamily, *Monotoideae* is represented in Africa and Madagascar, with some 36 *spp.* of *Monotes* A.DC. and a few species of *Marquesia* GILG (cf. BANCROFT, 1935).

Subfamily *Dipterocarpoideae*, comprising 13 genera and some 470 *spp.* ranges from the Seychelles through Ceylon (where a proportionally large diversification exists) to the south of Peninsular India, and then to East India, Bangladesh, Burma, Thailand, Indo-China, to continental S. China (Yunnan, Kwangsi, S. Kwantung, Hainan) and through Malesia southeastwards to the D'Entrecasteaux Is. off S.E. Papua (not in New Britain and New Ireland), and northwards to the Batan Is. north of Luzon, Philippines.

(1) With some co-operation of the General Editor for the general chapters.

Drawings by Miss R. van Crevel (details) and Mr. J. van Os (habit) were made under supervision of Dr. M. Jacobs.



Fig. 1. Characteristic habit of the large *Dipterocarpaceae* with high unbranched bole and huge dome-shaped crown: *Shorea rubella* ASHTON, from Brunei (Photogr. ASHTON).



Fossils do not significantly extend subfamilial range in Asia and Malesia, but they do essentially so in East Africa. Fig. 2.

In Malesia 10 genera with 386 *spp.* occur, predominantly in the humid non-seasonal areas, absent only from the seasonal area encompassing the Lesser Sunda Is. east of Sumbawa as far as the Tenimber Is.

The local species diversity of these genera is very uneven, with a tendency to decline eastwards, as is shown by the total number of species per island. Fig. 3-4. See also Fig. 19, 28, 43, 65, and 79.

Three of the 10 genera are endemic in Malesia, *viz* the monotypic genus *Upuna* in Borneo, *Neobalanocarpus* in Malaya (& Pattani adjoining Kelantan in N. Malaya), and the genus *Dryobalanops* (7 *spp.*) on the Sunda shelf (Sumatra, Borneo, Malaya); the 7 others Malesia shares with continental Asia, and Ceylon (except *Anisoptera* and *Parashorea*). A further three are endemic to Southern India, Ceylon and the Seychelles.

Four genera range widely through Malesia and also have species (mostly few) in East Malesia (Celebes, Moluccas, and New Guinea), *viz* *Anisoptera* (11 *spp.*, 10 in Malesia), *Vatica* (65 *spp.*, 55 in Malesia), *Hopea* (102 *spp.*, 84 in Malesia), and *Shorea* (194 *spp.*, 163 in Malesia).

Of the remaining three *Cotylelobium* (6 *spp.*, 3 in Malesia) is known in Malesia only from the Sunda shelf islands, while *Dipterocarpus* (69 *spp.*, 53 or 54 in Malesia) and *Parashorea* (14 *spp.*, 10 in Malesia) occur on the Sunda shelf islands, but also in the Philippines.

Some of the Malesian genera formerly had in the Tertiary a wider distribution, *e.g.* *Dryobalanops* occurred in West Java and Southern India, *Dipterocarpus* in N.E. Africa, and *Anisoptera* (now only from Chittagong and Burma southeastwards) in India.

It is noteworthy that there are hardly any clear disjunctions in the generic ranges (apart of course from seas separating adjacent islands), the exception being that of *Cotylelobium*, with 1 *sp.* in Ceylon and further from S. Thailand to West Malesia which stems obviously from extinction. *Vateria* and its close ally *Vateriopsis* are confined to Ceylon and the Seychelles respectively; this huge oversea gap must be ascribed to ancient geomorphological processes.

*Species ranges.* I have (1972) discussed the relationship between the ecological and geographical ranges of dipterocarps, and speculated on their evolutionary significance. Patterns of Malesian dipterocarp distribution can be summarised as follows:

*Widespread species.* These form 4 principal categories: (1) The first, those which occur both in seasonal and non-seasonal zones, often tend to be gregarious in the former and occur there on a wider range of substrates; but in the latter they become local, scattered, and confined to deep fertile soils where leaching is least apparent, especially on basic and intermediate igneous rocks, calcareous shales, and around the base of limestone hills. *Shorea assamica*, *S. guiso*, *Dipterocarpus gracilis*, *D. hasseltii*, *D. kerrii* and *Anisoptera costata* serve as examples. — (2) The second category are those of wide Malesian distribution in the non-seasonal zone, often including the Philippines: these occur on the granite of the Sunda core but spread through the region on other igneous rocks and on the deep clay soils of the shale and phyllite ridges of the great sedimentary geosynclines. — (3) Thirdly are those of freely drained yellow/red soils prone to drought and of moderate to low fertility, mostly of coastal hills and islands though some extend up inland ridge-tops; coastal N.W. Borneo is the present centre of distribution, but a relict distribution which frequently includes eastern coastal Malaya, and less frequently Riouw, Perak (W. Malaya), S. Borneo and rarely E. Sumatra suggests a more extensive former continuity of this habitat. — (4) Lastly are the minority of riparian species, many of which may be of recent origin, being rapidly dispersed by freshwater by means of their floating fruits.

What is said about the coherence of generic ranges holds also for species ranges which rarely show disjoint distributions (*Dipterocarpus retusus*, the continental *D. turbinatus* GAERTN. *f.*, and *Shorea roxburghii* are notable exceptions), though several Ceylon species are vicarious with others in Malesia and similar distant vicarism occurs on either side of Wallace's line.

*Endemicity.* *Dipterocarpaceae* show a high rate of endemicity in the non-seasonal humid tropics not reflected in the more seasonal parts of their range. Fig. 4. This may be ascribed to their poor fruit dispersal in a windless climate, allowing easy isolation by natural barriers such as quite small river valleys (ASHTON, 1969, 1972), and rapid edaphic specialisation. Endemicity, both local and island-wide, is greatest in New Guinea (73% of 15 *spp.*) and Borneo (59% of 267 *spp.*), and high in the Philippines (46½% of 45 *spp.*); in Sumatra (11½% of 96 *spp.*) and Malaya (19% of 156 *spp.*) it is

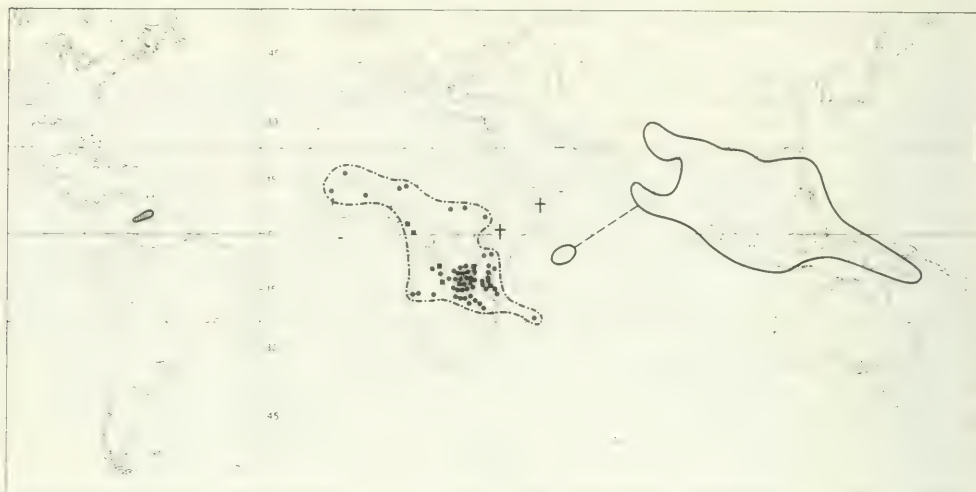


Fig. 2. Range of the *Dipterocarpaceae*: *Dipterocarpoideae* (line and 2 fossil sites in E. Africa), *Monotoideae* (2 genera, Afro-Madagascan, interrupted line, dots *Monotes*, squares *Marquesia*), *Pakaraimoideae* (monotypic genus in northern South America).

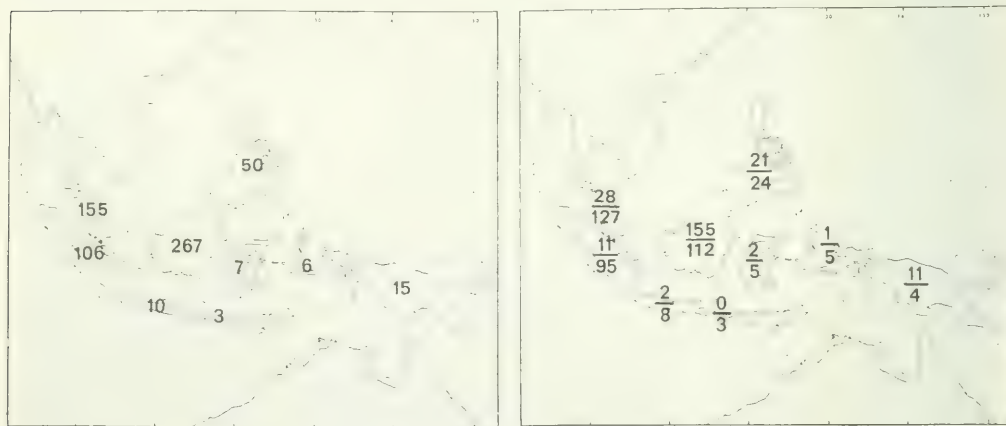


Fig. 3. Density map of *Dipterocarpaceae* in Malesia, total number of species in each island.

Fig. 4. Density map of *Dipterocarpaceae* in Malesia, segregated into endemics (above the hyphen) and non-endemics (below the hyphen).

surprisingly comparatively low. Explanations may possibly be sought in the central position within the Sunda shelf and the relative edaphic uniformity of Malaya and Sumatra, the prevailing archipelagic condition of the Philippines with only intermittent connections with Sundaland during the late Tertiary and Quaternary period, and the youthful physiography and hence edaphic diversity of New Guinea and Borneo. The close proximity of all Borneo to, and frequent absorption into, Sundaland and its central position in western Malesia have probably also led to periodic enrichment by immigration followed by local evolution in ensuing periods of isolation.

*Literature:* ASHTON, Biol. J. Linn. Soc. 1 (1969) 155; Proc. 2nd Aberdeen Hull Symp. Mal. Ecol.



(1972) 35; BANCROFT, *Am. J. Bot.* 22 (1935) 511, f. 1 (map); MAGUIRE & ASHTON, *Taxon* 26 (1977) 341.

**Fossils.** Fossil data of the family have been surveyed by R. N. LAKHANPAL (1974). Fossil wood and leaf impressions which have been identified with the *Dipterocarpaceae*, and which anatomically apparently differ little from present day genera, have been recorded from both East Asia and Africa. The winged specimens, apparently fruits, called *Calycite*, from the Upper Cretaceous strata of the east coast of the United States, and compared by BERRY (1914) to *Dipterocarpaceae*, and *Woburnia*, a similar structure from the Lower Cretaceous of Bedfordshire (England) similarly compared by STOPES (1912) are both considered by BANCROFT (1933) to be too incomplete for determination. SCHWEITZER (1959) who studied and surveyed the records of fossil wood of *Dipterocarpaceae* considered, however, that the *Woburnia* wood is distinctly Dipterocarpaceous and does not differ very much from recent woods. WOLFE *et al.* (1975) correctly pointed out that on the *Woburnia* site no other samples could be found and concluded, it seems correctly, that the specimen must have been mislocalised.

RASKY (1956) claimed to have found a flower in the Upper Miocene of Budapest, referred to *Monotes* (CHANDLER, 1964: 81). WEYLAND (1964) mentioned that fruit fragments from the Oligocene of the Zevenberge and the Miocene of Oehningen would belong to the fossil *Monotes macranthus* (HEER) WEYLAND. KIRCHHEIMER (1957) was earlier of the opinion that these remains are too inadequate to warrant inclusion in *Monotoideae*. The only authenticated fossil fruit is that of *Dipterocarpus verbeekianus*, recorded by HEER (1874, 1883) from the Tertiary in Sumatra.

**Leaf impressions.** HEER (*l.c.*) recorded *Dipterocarpus* leaf impressions from the Tertiary in Sumatra; later authors have confirmed his conclusions. CRIÉ (1888) recorded Pliocene leaf impressions of a possible *Dipterocarpus* from Java, while SCHUSTER (1911) identified Pleistocene Javanese impressions as *Hopsea fagifolia* (*H. sangal*) and *Vatica lanceaefolia* BL. EDWARDS (1923) recorded the modern Philippine species *Anisoptera thurifera*, *Shorea guiso* and *S. polysperma* from the Pliocene in Luzon. The records of dipterocarp leaves from the Tertiary of Labuan, North Borneo by GEYLER (1887) are not considered by BRANDIS (1895) or EDWARDS (*l.c.*) to merit inclusion. WOLFE (1972) claimed to have found an Eocene (para-)tropical flora in Alaska, in which also leaf impressions of *Anisoptera* occurred. Such a geographically remote record must require substantiation by more unequivocal material.

**Wood.** KRÄUSEL (1922, 1926) has recorded undoubted dipterocarp woods from the Tertiary (claimed then to be Miocene) of southern Sumatra and West Java, which have been associated by DEN BERGER (1923, 1927) with *Shorea* and *Dryobalanops*, his *D. spectabilis* and *D. javanica* being the only records of that genus from Java. KRÄUSEL's *Caesalpinioxylon palembangense* is considered by DEN BERGER, and later KRÄUSEL himself, to be *Shoreoxylon*. *Dipterocarpoxyton annamense* of COLANI (1919), from the Tertiary of Annam, is only tentatively accepted by EDWARDS. The specimen of *Dipterocarpoxyton* described by HOLDEN (1916) from Burma possesses uniseriate rays, unlike all Asiatic genera, and does not bear secretory canals throughout the wood; hence the identity is insufficiently grounded, but PRAKASH (1973) has subsequently confirmed the fossil genus from Burma. *Shoreoxylon* has been identified from the Tertiary of Assam by EYDE (1962), while Miocene fossil woods from the east coast of Southern India have been identified by NAVELE (1962) as *Anisopteroxyton*, *Dipterocarpoxyton*, *Hopsoxyton*, and *Shoreoxylon* and by him and AWASTHI (1971) as *Dryobalanoxylon*. Fossil wood from Quaternary sites, *c.* 10,000 years old, from the Siwalik hills, N. India, and from W. Bengal have been identified with *Anisoptera* by GHOSH & GHOSH (1958), and GHOSH & KAZMI (1958).

SCHWEITZER (1959), who made a major study of fossil wood of *Dipterocarpaceae*, gave maps of fossil sites. It is interesting that he identified fossil wood from Timor as *Shoreoxylon* — an island where the family does not now occur — and that he recorded *Dryobalanoxylon* from several places where the genus is at present absent, *viz* Cambodia, S. Sumatra, W. Java, and Ambon in the Moluccas.

It is agreed that no fossil wood is found older than the Miocene.

**Pollen.** J. MULLER's studies of pollen (1970) indicate that the thin walls do not preserve well, and the lack of distinctive sculpturing or other diagnostic characters combines to limit their value in the fossil record. It is noteworthy that he found the pollen percentage proportionally always low, even in stands on peat completely dominated by *Shorea albida* where it comprised only a few percent.

This is against expectation, and the reason is unclear. MULLER suggested that much pollen is devoured by thrips, but then the persistent exines should be found.

CHANDLER (1964: 36) mentioned (with a question mark) Oligocene pollen from the London Clay Flora, but she appeared far from assured of this identification as she remarked later (*l.c.*: 56) that she found the apparent absence of Dipterocarpaceous fossils strange. The identity of the pollen record (by MA KHIN SEIN) is very much doubted by J. MULLER.

MULLER (1964) found pollen of *Dipterocarpus* and *Dryobalanops* in the Tertiary of Borneo (Brunei), the first genus being represented from the Oligocene (MULLER, 1970), the latter from the Miocene.

The fossil record of *Dipterocarpaceae* in Asia and Malesia rests therefore on the wood fossils of several genera in India and West Malesia from the Tertiary (mostly Miocene and later) and the pollen records of the same age, but also on the presence of pollen of *Dipterocarpus* already in the Oligocene of Borneo.

*Northeast African fossils.* Fig. 2. In 1933 BANCROFT described *Dipterocarpoxylo africanum* from the Tertiary beds near Mt Elgon (Kenya). In the same year CHIARUGI described three species of *Dipterocarpoxylo* from the ?Plio-Pleistocene beds of Somaliland which SCHWEITZER (1959) later considered to be identical with *D. africanum* BANCROFT. The fossil woods collected by WEYLAND (1964) from the volcanic tuffs of Mt Elgon, of uncertain date but probably of late Tertiary and pre-Pleistocene times, also undoubtedly represent dipterocarp material and must be associated with the Asiatic subfamily and show strong evidence of being congeneric with *Dipterocarpus*, supporting CHIARUGI's identification. In 1935 SEWARD had described a few leaf impressions from the Nubian sandstone of Egypt as *Dipterocarpophyllum humei* and *D. zeraibense*; the age of the strata being uncertain but probably Tertiary. Finally LAKHANPAL (1974) mentioned that Prof. Y. LEMOIGNE had told him that he had found a dipterocarp wood in an Upper Tertiary deposit in Ethiopia to be described in a future paper.

Concluding, it is clear that *Dipterocarpoideae* were present in East Africa at least in the Upper Tertiary. It is difficult to imagine that they would have been derived from the Indian subcontinent, as according to geophysical theory this rafted block of land had by then hardly joined the Asian plate while, moreover, *Dipterocarpus* could hardly have migrated through the desert zones of S.W. Asia. Thus, even the poor fossil record presents formidable implications. The alternative is that *Dipterocarpoideae* were already earlier represented in N.E. Central Gondwanaland. It is a pity that the older fossil record in S.W. Asia and N.E. Africa is so scant, as this area is vital for understanding exchange of the Gondwana element and tropical S.E. Asia.

*Literature:* AWASTHI, Palaeobotanist 18 (1971) 229; BANCROFT, Fören. Förhandl. 55 (1933) 59; Am. J. Bot. 22 (1935) 164; DEN BERGER, Verh. Geol.-Mijnb. Gen. Ned. & Kol. 7 (1923) 143; Bull. Jard. Bot. Btzg III, 8 (1927) 495; BERRY, U.S. Geol. Surv. prof. paper (1914) 84; BRANDIS, J. Linn. Soc. Bot. 31 (Nov. 1895) 243; CHANDLER, London Clay Flora, Suppl. London, 1961, The Lower Tertiary Floras of Southern England. IV. Summary & survey of findings in the light of recent botanical observations (1964) 36, 56; CHIARUGI, Palaeontographica Hal. 32, n. 1 (1933) 106; COLANI, Bull. Serv. Géol. Indochine 6, n. 3 (1919) 2; CRIÉ, Samml. Geol. Reichsmus. Leiden I, 15 (1888) 1; EDWARDS, Geol. Mag. 60 (1923) 159, 409; EYDE, Palaeobotanist 11 (1962) 115; GEYLER, Vega-Exp. Vetensk. ikttagelser 4 (1887) 473; S.S. GHOSH & A.K. GHOSH, Sci. & Cult. 24 (1958) 238; S.S. GHOSH & KAZMI, Sci. & Cult. 23 (1958) 485–487; HEER, Abh. Schweiz. Palaeontolog. Ges. (1874); Neue Denkschr. Allg. Schweiz. Ges. Gesamt. Naturw. 28 (1883) 1; HOLDEN, Rec. Geol. Surv. India 17 (1916) 47; KIRCHHEIMER, Die Laubgewächse der Braunkohlzeit (1957) 432; KRÄUSEL, Verh. Geol.-Mijnb. Gen. Ned. & Kol. 5 (1922) 231; Proc. Kon. Ak. Wet. A'dam, sect. sc., 25 (1922) 9; Leid. Geol. Meded. 2, n. 1 (1926) 1; LAKHANPAL, Birbal Sahni Inst. Palaeobot. Spec. Publ. 1 (1974) 30–39; MULLER, Abstr. 10th Int. Bot. Congr. Edinb. (1964) 271; Biol. Rev. 45 (1970) fig. 5 facing p. 435; NAVALE, Palaeobotanist 11 (1962) 66; PRAKASH, Palaeobotanist 20 (1973) 48–70; RASKY, Fossil plants from the marl formation of the environs of Budapest; Földt. Közl. Budap. 86 (1956) 167–179; SCHUSTER, Abh. K. Bayer. Ak. Wiss. M.-Ph. Kl. (1911) 25; SCHWEITZER, Palaeontographica 105B (1959) 1–66; SEWARD, Leaves of Dicotyledons from the Nubian Sandstone of Egypt; Min. Finance Surv. Dept. Egypt (1935) 1–21; STOPES, Phil. Trans. R. Soc. B 203 (1912) 75; WEYLAND, Lehrbuch der Paläobotanik ed. 2 (1964) 455; WOLFE in Graham (ed.), Floristics and Paleofloristics of Asia and Eastern North America (1972) 207–208, pl. 3, f. 3; WOLFE c.s. Ann. Mo. Bot. Gard. 62 (1975) 819.



Ecology. *Overall range.* Confined to tropical climates with a mean annual rainfall exceeding 1000 mm, and/or a dry season of less than 6 months. Most species do not occur above c. 1000 m where an important floristic transition occurs; a few are  $\pm$  entirely confined above 700 m. Above 1500 m records are spurious: a *Shorea* sp. in N. Sumatra at 1700 m and *Hopea beccariana* BURCK in Brunei at 1750 m. The subfamily geographical range is divisible into three climatic zones:

*Savanna zone.* A limited number of Indo-Burmese species are fire-tolerant: *Shorea robusta*, the Indian Sal, *S. roxburghii* and the Indo-Burmese *S. obtusa*, *S. siamensis*, *Dipterocarpus obtusifolius*, *D. tuberculatus* and *D. intricatus*. They are distinguished by their thick bark (the latter 3 are the only fissured members of their genus) and are the only dipterocarps to be deciduous for a more or less prolonged period during the dry season. They form single species or codominant stands on the well-drained plains, and dry hills (occasionally to 1400 m) of Central and East India, Burma, Thailand and Indo-China. Generally the fire-climax savanna woodlands (Dry Dipterocarp forests of CHAMPION, 1936) in which they occur grow on infertile, yellow skeletal hill soil and laterite bearing red soils in the plains in areas with less than 2000 mm mean annual rainfall and 3–5 months dry season; these forests do not exist in Malesia, but *Shorea siamensis* and *Dipterocarpus obtusifolius* occur, on dry rocky headlands and old secondary forest (schima-bamboo forests of SYMINGTON, 1943) respectively in Perlis, N.W. Malaya, where there are regularly 1–2 consecutive dry months at the end of each year. In the foothills of the sandstone mountains of Arakan and southern Cambodia the Dry Dipterocarp forests themselves extend, probably following the advent of man-induced fire, into areas with a dry season of but 1–2 months and more than 2000 mm rainfall, on porous yellow podsolc sands; here they are floristically impoverished, and of the dipterocarps only *D. intricatus* and *D. obtusifolius* remain. They flower annually shortly before, during, or after leaf fall during the dry season, and the ripe fruit fall after the coming of the following rains. Regeneration is abundant in disturbed forest; the saplings are cut back annually by fire and drought, the roots often becoming deep and extensive before a permanent leader is established. Mature trees sucker readily in response to damage. At the more humid climatic and edaphic ends of their range these species become more shortly deciduous or evergreen.

*Malesian species occurring in the seasonal evergreen forest zone* (there are three categories, species of wide distribution, i.e. occurring in both seasonal and aseasonal evergreen forest, species confined to seasonal forest marked with \*, and species occurring on drought-prone sites in the aseasonal tropics marked with +):

ANISOPTERA	<i>ferrea</i> *	<i>farinosa</i> *
<i>costata</i>	<i>forbesii</i> *	<i>gratissima</i> +
<i>scaphula</i> +	<i>glabrifolia</i> *	<i>guiso</i>
<i>thurifera</i>	<i>gregaria</i> *	<i>henryana</i> *
COTYLEOBIUM	<i>griffithii</i>	<i>hypochra</i> *
<i>melanoxyton</i>	<i>helferi</i> *	<i>laevis</i>
DIPTEROCARPUS	<i>iriana</i>	<i>montigena</i> *
<i>baudii</i> *	<i>malibato</i>	<i>negrosensis</i>
<i>costatus</i> +	<i>novoguineensis</i>	<i>palosapis</i>
<i>dyeri</i> *	<i>odorata</i> *	<i>polita</i>
<i>gracilis</i>	<i>pedicellata</i>	<i>polysperma</i>
<i>grandiflorus</i> +	<i>philippinensis</i>	<i>roxburghii</i> *
<i>hasseltii</i>	<i>pierrei</i> +	<i>selanica</i> *
<i>kerrii</i> +	<i>plagata</i>	<i>siamensis</i> *
<i>littoralis</i> *	<i>sangal</i>	VATICA
<i>obtusifolius</i> *	<i>ultima</i> *	<i>bantamensis</i> +
<i>philippinensis</i> *	PARASHOREA	<i>cinerea</i> *
<i>retusus</i>	<i>malaanonan</i>	<i>flavovirens</i> *
HOPEA	<i>stellata</i> *	<i>lowii</i>
<i>acuminata</i>	SHOREA	<i>mangachapoi</i> +
<i>bilitonensis</i> *	<i>assamica</i>	<i>odorata</i>
<i>cagayanensis</i> *	<i>contorta</i>	<i>pachyphylla</i> +
<i>celebica</i> *	<i>falcifera</i>	<i>rassak</i>

*Seasonal evergreen forest zone.* The vast majority of dipterocarps are therefore confined to areas where the mean annual rainfall exceeds 2000 mm. The presence of even a short but regular dry season, which in N.W. Malaya, for instance, hardly exceeds a month, has a profound influence on both number and kinds of species present. 62 Malesian species occur where there is a regular season of at least one month with less than 100 mm rainfall, 25 appear to be confined there, and a further 9 extend into the aseasonal zone only on sandy, coastal and skeletal ridge soils prone to water stress; these figures exaggerate the species diversity of dipterocarps in any one region, for all but 7 of the species occur in only one of the three Malesian seasonal regions: the north-west of the Malay Peninsula and northern Sumatra, seasonal parts of the Philippines, and the Moluccas and New Guinea. The relative floristic poverty of dipterocarps in seasonal evergreen forest is reflected in the flora in general: STAMP (1925) cited merely 'at least 1000 tree species' in these forests in all Burma; an estimated 400 species occur in the seasonal evergreen forests on the southern flanks of the Cardamom mountains in southern Cambodia; by contrast 2,500 occur in the non-seasonal parts of lowland Peninsular Malaya. No estimates of the total species diversity of the seasonal evergreen forests in Malesia exist. Such areas are widespread in the Philippines, S. Celebes, some local parts of the Moluccas, and S. New Guinea. It is noteworthy that no fire-resistant or deciduous species of dipterocarps occur in Malesia, such as are known from certain tracts in continental S.E. Asia with Dry Dipterocarp forest.

East of Sundaland the dipterocarp flora becomes increasingly impoverished. See Fig. 3, 4, 19, 28, 43, 65, and 79. The fact that even in the non-seasonal New Guinean lowlands only a single section of *Hopea* has undergone an ebullition of speciation suggests that the poverty of dipterocarp species east of Wallace's line is in part due to probably geologically recent immigration there; clearly Makassar Straits must have been a formidable barrier, although it is, at its narrowest point only a mere 125 km wide, and southwards not exceeding 275 km. Two features underline this: firstly that Borneo possesses over 250 species and Celebes only 8, which can never be ascribed to climatic difference between Borneo and Celebes; secondly, of these 8 species there are 2 endemic (*Hopea celebica* and *Vatica flavovirens*), 2 are shared with the Moluccas (*Hopea gregaria*, *Shorea montigena*); *Shorea assamica* is a wide, from Assam to Malaya and Sumatra, with *ssp. philippinensis* in the Philippines, and *ssp. koordersii* in Celebes, the Moluccas and Philippines, and some doubtful sterile specimens in S.E. Borneo (represented in aseasonal parts of Borneo by the vicariant *S. agamii*); *Anisoptera costata* ranges from Burma to Borneo and Mindanao (one record); *A. thurifera* occurs in the Philippines, Celebes, Moluccas, and New Guinea; the last, *Vatica rassak*, ranges from Borneo to New Guinea, but is also found in the Sulu Archipelago joining Borneo and the Philippines just north of Celebes. None of these species which occur both west and east of Wallace's Line is not also found in the Philippines, suggesting that they spread along the Philippines over Wallace's Line and avoided Makassar Straits by marching northwards around it. In the south a single species, *Dipterocarpus retusus* transgresses Wallace's Line from Bali through Lombok to Sumbawa; if the fossil record of *Shorea* in Timor is correct too, a southern route eastwards via Java and the Lesser Sunda Islands, avoiding Makassar Straits, might also be imagined.

The tendency towards gregariousness persists into the seasonal evergreen forest zone, but is there more pronounced on impoverished soils and in areas probably colonised in geologically recent times. An example of the former are the *Dipterocarpus costatus* dominated forests on the impoverished sandstone soils of Arakan and southern Indo-China; this species also occurs between 700–1100 m in the mountains of S.E. Asia, but in non-seasonal Malaya ceases to be gregarious. This differential in gregariousness occurs also with several other widespread species, including *Anisoptera costata*, *A. scaphula*, *A. thurifera*, *Dipterocarpus gracilis*, *Shorea assamica*, *S. contorta*, *S. guiso*, and *S. hypochra*. In eastern Malesia several species are gregarious (see VAN SLOOTEN, 1952). The majestic stands of *kayu bapa* (*Shorea selanica*) on the hills of Buru below 1000 m and on the Sula Is. are celebrated. *Shorea assamica ssp. koordersii* is gregarious in Celebes, the Sula Is. and Obi; *S. montigena* becomes locally gregarious in Buru; *Anisoptera thurifera* is gregarious both in the seasonal zone of the Philippines and in New Guinea where it is grouped along the crests of steep-sided ridges below 800 m over large areas; in New Guinea *Hopea forbesii* is also often gregarious in the south-east.

Dipterocarp populations in these seasonal evergreen forests flower more or less regularly annually too, from November to March in the Indo-Burmese region including N.W. Malaya (e.g.



BURGESS, 1972) and also the Philippines. Flowering, and even more fruit set, is heavier in some years than others; not all individuals flower; in Thailand less than half the trees in a stand that are of flowering age normally flower in any one season and a minority of these flower in two consecutive seasons (SMITINAND's and personal observations). The developing fruit are much infected by beetle larvae while parakeets favour the ripe fruits. In *Dipterocarpus* many seasons may consequently pass without a single seedling becoming established. Germination is immediate on falling. Several species are shortly deciduous in seasonal evergreen forests including some, such as *Dipterocarpus gracilis* and *Anisoptera costata* which are evergreen in non-seasonal western Malesia, but none are deciduous for a prolonged period.

Mountains higher than 1000 m along the coasts and around the head of the great valleys of the seasonal Far East, even at latitudes higher than the normal range of lowland evergreen forests, collect cloud and comparatively humid though still seasonal conditions prevail on their slopes. The species occurring at these latitudes in the Indo-Burmese region and Java, *Dipterocarpus costatus*, *D. gracilis*, and *D. retusus*, occur also in the mountain forests of Malaya.

*Non-seasonal humid zone.* As this is the zone to which the great majority of Asian, including Malesian, dipterocarps are confined a review of the biological characteristics of the family here must prelude considerations of climatic and edaphic ranges of the species and their overall role in the forest communities.

*Reproductive biology.* A most important characteristic of the family in the non-seasonal zone is its flowering behaviour. Flowering does not occur annually, but at  $\pm$  irregular intervals and then of varying intensity though gregariously, species from most or all genera flowering in a single season (this includes those species that occur, and flower annually, in seasonal evergreen forests) (WOOD, 1956; MCCLURE, 1966; MEDWAY, 1972; COCKBURN, 1975). In a heavy flowering nearly all species in an area may flower, and the majority of individuals; more frequently probably less than half the individuals flower, though critical observations of this kind have only been made by BURGESS in the semi-gregarious species *Shorea curtisii* (1972). Gregarious flowering may occur in a single river valley or throughout a region as large as N.E. Borneo. The 1955 general flowering in Sabah was observed by WOOD, when over 2/3 of the 200 species then known in that state were collected fruiting, and when the only area not to experience a general flowering was the extreme south-east. His description summarises the main features seen in dipterocarp flowerings elsewhere in this zone. All genera flowered concurrently over a period of a few weeks in a single area, though there was a slight delay west of the Crocker range compared with the east, and one of as much as two weeks towards the upper altitudinal limits both in exclusively montane species (some of which flowered poorly or not at all) and in species of wide ecological amplitude. At the height of the flowering in Sepilok Forest Reserve, Sabah, 'the ground appeared to be carpeted in snow and the scent of the flowers pervaded the jungle'. Detailed observations showed great variation in the period during which anthesis occurred between closely related species; in some sections of *Shorea* it continued over a period from May until as late as August in the lowlands and November in the mountains. ASHTON (1969) observed that anthesis of individual species in *Shorea* sect. *Richetioides* in Andulau Forest Reserve, Brunei hardly overlapped, being sequential through the flowering season. CHAN & APPANAH (1980) have demonstrated, by meticulous phenological study of numbered wild trees, that species which flower early do so within 15 days, but flowering of the last species is over a period of to 25 days. WOOD also observed that some, such as *Dryobalanops lanceolata*, flowered heavily over a short period, whereas in the taxonomically isolated *Shorea smithiana* anthesis occurred over a very long one; in *S. curtisii* stands it may continue over several months (BURGESS, 1972). Among the main canopy and emergent species WOOD noted that flowering was general and heavy over the whole crown, but in understorey species of e.g. *Hopea* and *Vatica* flowering was more sporadic and often restricted to a few branches. Young trees of canopy species do not flower at all until their sympodial crown is developed in direct sunlight. WOOD found that some species failed altogether to flower, several of which in *Parashorea* and *Vatica* were known to have flowered the previous year. It was of particular interest that, of the species that did not flower, the majority were either montane or in the peat swamps. In the latter habitat, mostly confined to the west coast, no dipterocarp flowered. From forestry records over many years and personal observations of flowering periodicity in *Shorea curtisii* and related species BURGESS concluded that local flowering is more frequent than generally supposed, and this has been supported by others (e.g. ASHTON *et al.*, 1979), though fruit set rarely

occurs following a minor flowering. Closely related species differ in flowering periodicity. *Dryobalanops aromatica* and *Shorea leprosula* populations, for instance, flower on average once every two years, while *S. parvifolia* flowers only half as frequently and the important hill forest species *S. curtisii* and *S. platyclados* at intervals not exceeding five years. In *Dryobalanops aromatica* and *Shorea curtisii* local flowering can be found somewhere in Malaya almost every year and sometimes occurs in two successive years in one area; this has also been observed in *Shorea sect. Pachycarpae* in West Sarawak (e.g. SMYTHIES, 1958). BURGESS observed that individual trees of *Shorea curtisii* do not, as a rule however, flower in two successive flowerings. He also observed that in *S. curtisii* the flowering in 1968 could be subdivided into two almost distinct periods during which two separate sets of individuals within a single gregarious population flowered. Planted dipterocarp trees, and trees in forests previously selectively felled, flower more frequently, and generalisations about dipterocarp flowering in natural conditions which are derived from observations on such trees can be misleading (e.g. SASAH *et al.*, 1979). *Vatica rassak* and *Shorea macrophylla* flower almost annually in the arboretum of the Forest Research Institute at Kepong (Malaya) as apparently do several species at Bogor and a *Shorea stenoptera* provenance in a remarkable trial plantation nearby in W. Java, in which all plants are said to have been derived from a single tree near Pontianak that was well known for its annual flowering.

Emergent species probably take many years to reach flowering age under forest conditions. At Kepong cultivated saplings of *Dipterocarpus oblongifolius* have flowered after only 7 months (KOCHUMMEN, 1961), but fruit was not set and cultivated trees there normally started flowering after 15–30 years (NG, 1966). TANG (1978) has recorded young trees of *Shorea leprosula*, growing following selective felling, to set viable fruit after 7 years.

*The cause of flowering* remains obscure. It can occur between March and July, with a peak in May, in Malaya and East Borneo; but a month or two later on average in N.W. Borneo. Both WOOD and BURGESS have shown that the commonly held belief that general flowerings follow a period of abnormal water stress is not consistently supported by data from rainfall stations; nevertheless the fact that many other families (e.g. *Burseraceae* and *Sapotaceae*) also flower unusually heavily in a good dipterocarp year (e.g. MEDWAY, 1972), indicates that an undefined climatic factor must be involved. PALMER (1979) rightly pointed out that the climatic trigger must be easily observable outside the forest as its effects are regional. NG (1978) has suggested that flowering may be initiated by a period of high irradiation. WYCHERLEY (1973) demonstrated highly significant statistical correlation between gregarious flowering of dipterocarps and preceding periods with both large diurnal temperature ranges and high maximum temperature indicating high insolation; he deduced that the latter is probably the main inductive factor, and this view is also supported by NG (1978). Heavy flowerings never occur in successive years. It appears possible therefore that accumulation of assimilates, including carbohydrates within the trees, takes place gradually following a flowering, so that in each subsequent year the threshold, over which the climatically induced trigger is effective, becomes lower until the combination of an adequate assimilate level and adequate climatic stimulation induces formation of inflorescence primordia; the intensity of flowering may thus be related to the degree to which the threshold is exceeded. Differential rates of inflorescence and flower development among the species leads to spacing in the periods of anthesis of individual species.

*Pollination.* No reference occurs in the literature. Meliponid bees (*Trigona* spp.) are, according to BURGESS, abundant in the crowns of flowering *Shorea curtisii* and other Malayan dipterocarps; CHAN & APPANAH (1980) have found them to be principal pollinators of *Dryobalanops* and *Neobalanocarpus*; as they are short distance foragers that tend to keep to a single crown, and as they are glabrous or sparsely hairy and very efficient at cleaning themselves, they are unlikely to be effective pollinators of trees that present many flowers at a time (D. H. JANZEN, comm.). SMITINAND reported to me that honey bees are abundant round *Dipterocarpus* crowns, but they have not been observed on the flowers of other genera. Thrips (*Thysanoptera*) frequent the flowers of many *Shorea* and *Hopea* (personal obs.; CHAN & APPANAH, 1980) and are undoubtedly pollinators. Geometrid moths and beetles visit some dipterocarp flowers at night, but have not been demonstrated to effect pollination. The very large numbers of flowers on each tree, and the spatial isolation of the understorey species, may be expected to lead to rarity of outcrossing; the infrequency of flowering and its intensity would tend to prevent vector numbers from reaching adequate levels for effective pollination even were they polylectic (promiscuous).



*Fruiting.* Perhaps as a result of these problems of pollination, few fruit develop on each many-flowered inflorescence, and in some years none, though heavy rain following anthesis is also generally regarded as disastrous (SMYTHIES) and the main determinant of a successful crop. The fruit are heavily parasitised by weevils of the genera *Alcydodes* and *Nonophyes*, also the scoliid *Poecileps* and some *Lepidoptera* (DALJEET SINGH, 1974), especially following minor flowerings when seedlings rarely become established. These beetles are apparently not host specific, and increase greatly and suddenly in numbers in flowering years though their life cycle is known to take 18 months. BURGESS (1969) estimated that c. 80% of *Shorea curtisii* seed on average is destroyed by these predators. The genus *Dipterocarpus* is particularly susceptible.

*Fruit development.* As a consequence of the above fruiting years are less frequent than flowering years. CHAN (1980) found in the 1976 flowering in West Malaysia that, though there was an interval of 61 days between the onset of anthesis in the first and last of six *Shoreas* in sect. *Mutica* growing together in Pasoh forest, fruiting started within 10 days of one another and the fruiting periods otherwise completely overlapped. This can be accounted to the fact that the period between anthesis and first fruit set was 82 days for the first to flower, 126 for the last. This phenomenon appears general in the family; differentials in rates of development vary between related species rather than between genera therefore. Together, these factors lead to occasional heavy fruitings in which enormous quantities of seed from a majority of species in an area are set  $\pm$  concurrently and germinate immediately on the forest floor.

*Dispersal.* Though the prolonged fruit sepals allow the fruit to gyrate and fall obliquely, once within the main canopy they fall in random directions and on average almost vertically; many get anchored in branches and die, and many main canopy and understorey species have re-evolved short fruit sepals. WEBBER (1934) observed fruit being dispersed up to  $\frac{1}{2}$  mile in local high winds; MULLER (personal comm.) has once seen the coastal cantonment of the Brunei Shell Petroleum Company, a flat strip of cleared land behind the sea beach, inundated by the fruits of the *Shorea albida* trees that fringe it on the inland side, observing a dispersal distance of c. 2 km. Such events must be unusual and as RIDLEY (1930) noted, the vast majority of the fruit fall within 100 m of the parent tree under forest conditions. BURGESS (1969) estimated that over one half of the seed of the ridge-top species *Shorea curtisii* landed within 20 m of the parent tree. Even during a dry spell at Bogor and with strong southern wind VAN STEENIS observed dispersal of *Shorea* grown in the Botanic Garden over the large lawn in front of the palace not to exceed c. 500 m.

The fruit with their resinous pericarps are not favoured by many terrestrial animals, though wild pigs devour them voraciously. The occasional heavy fruiting years undoubtedly minimise predation and reduce seed mortality (BURGESS, 1969); he stated that damage by foraging ants is so severe in *Shorea curtisii* that successful germination only occurs in heavy seed concentrations.

Some 20 dipterocarp species in West Malesia alone characteristically grow on periodically swamped riverain alluvium and river banks. Most of these species, including *Dipterocarpus apterus*, *D. tempehes*, *Dryobalanops oblongifolius*, *Shorea macrophylla*, *S. palembanica*, *S. seminis*, *S. splendida*, *S. sumatrana*, *Vatica pauciflora*, *V. rassak*, and *V. umbonata* have large fruit with short sepals and thick pericarps, but with these exceptions the fruits do not present any obvious adaptation for dissemination by water. BURKILL (1922) briefly discussed the adaptation for water dispersal in *Vatica pauciflora* (wallichii) and *Shorea seminis* (*Isoptera borneensis*) and found that the fruit of the former floats for c. 22 days while that of the latter, when deprived of its corky sepals, sinks within 2½ days. There is no evidence that dipterocarp seed can withstand sea water.

*Conditions for germination* appear to be crucial but have been little studied. Fruit of Malesian dipterocarps lacks dormancy, and attempts to induce dormancy by reducing water content and temperature have only had limited success (TANG, 1971; TANG & TAMARI, 1973). In general seed of *Dipterocarpaceae* is noted for its brief period of vitality; they do not stand drying out and seedling stages are clearly adapted to temperature, moisture, and light conditions of the primary forest. Dipterocarp seeds have no dormancy in nature and attempts at storage beyond a few weeks have failed in Malesian species. Indian foresters (e.g. GUPTA, 1936–38) have noted that *Dipterocarpus* seeds rarely survive where litter is thick on the forest floor, the radicle failing to penetrate it and drying up. The gregarious riparian Indo-Chinese *Dipterocarpus alatus* appears to regenerate only at prolonged intervals, when fruiting follows a flood in which the litter has floated away, leading to even-aged stands. BURGESS (1969 personal comm.) has germinated species in *Shorea* sect. *Mutica*



Fig. 5. Ground-carpet of seedlings of *Shorea multiflora* (BURCK) SYM., 9 months after flowering. Note the drip-tips. Brunei, Andalau For. Res., lowland dipterocarp forest, 100 m alt. (Photogr. ASHTON, Aug. 1959).

under controlled humidity conditions and found that species differ in their tolerance of dry conditions at germination: the coastal hill and ridge-top species *Shorea curtisii* is paradoxically highly sensitive to dry conditions at germination, though apparently more tolerant of water stress than related species at maturity. He estimated that 40% of *S. curtisii* seedlings fail to survive the first month following germination, and another 10% succumb in the following dry season c. 3 months later. Mortality in the life cycle is consequently greatest during fruit development and the 2–3 years following seedling establishment.

*General ecology.* Following successful establishment carpets of seedlings of a single species are seen around the boles of the parent trees. Fig. 5, 81. At this stage competition is therefore mainly intraspecific, and it is interesting that, though this is the period of maximal mortality, morphological and anatomical differences between allied species are at their least. Knowledge of the ecology of dipterocarp seedlings is almost entirely empirical, derived from silvicultural experience. SUNDERLAND (unpubl.) has demonstrated however that though seedlings of the slow-growing heavy hardwood *Shorea maxwelliana* and the fast growing light hardwood *S. leprosula* share compensation points, total daily net photosynthesis and rates of dark respiration are much higher in the latter. Though the former can survive under lower light intensities, neither can survive without the occurrence of sunflecks.

If, as seems probable, dipterocarps form complex *ectotrophic mycorrhizal associations* (HONG, 1979), then the clumped distribution imposed by their reproductive biology will facilitate and be enhanced by the events leading to the establishment of their rhizosphere associations. Many basidiomycetes are known to produce carpophores in response to drought; under lowland rain forest conditions carpophore formation appears to be, perhaps as a consequence, less frequent. In wetter areas it may be that reproduction is largely vegetative therefore, the mycelia persisting and



gradually spreading with the ever dispersing and coalescing clumps of the dipterocarp trees themselves.

Given all these conditions I conclude with MERRILL (1923) that "it becomes perfectly evident that, in order to explain the present distribution of *Dipterocarpaceae*, it is absolutely necessary to postulate previous land connections from India to New Guinea over which, at some time(s) in geologic history, it has been possible for certain species to march unimpeded."

The morphological differences by which the dipterocarp species are mainly recognised, in bark and twig as well as leaves, increase with age and reach their maxima once the crown has emerged into direct sunlight, branching becomes sympodial and the mature tree leaf is attained. In the largely understorey genus *Fatica* this differentiation does not occur and many species are difficult to identify unless fruiting. KENWORTHY (1969) demonstrated the physiological significance of various leaf characters of epidermal thickness, tomentum and wax deposits by which so many emergent species are distinguished. He found that in *Shorea curtisii* the stomata of the glabrous seedling leaves rapidly respond to water stress by closing, whereas in mature trees the stomata remained open at all times of day and are clogged by the abundant filamentous wax secretions that give the leaf undersurface of the species its characteristic appearance. The mature tree would act therefore as a giant wick and would have little control of water loss other than by the development of epidermal resistance. It is probable that the stomata are responsive in the freshly opened leaves, but rapidly become clogged by detritus and wax. It appears that leaf change, which is probably frequent and occurs at least once a year, is a crucial period which occurs only following times of rain when water stress is minimal. The conspicuous changes in colour and albedo as the leaves expand, and differences in these characters between individual trees, will create leaf temperature and hence transpiration differentials (SMITH, 1909). KENWORTHY (1971) also pointed out that the net, which is formed by the tertiary nerves and their associated sclerenchyma, effectively divides up the dipterocarp leaf into compartments like an aircraft wing, so that rigidity is maintained after prolonged drought or severe damage by predators.

Dipterocarp species vary greatly in *growth rates*: some, usually intolerant of low light intensities, show rapid growth rates and reach mature habit within 60 years under forest conditions; others, usually shade tolerant grow very slowly. The former probably have a life-span of c. 250, the latter perhaps in excess of 1000 years, judged on the basis of girth growth data.

*Range in non-seasonal zone.* Climates with at least 2000 mm mean rainfall and no regular season of pronounced water stress occur throughout Malaya, except the north-west, and in S.E. Peninsular Thailand (Pattani); throughout Sumatra except the north-west (Atjeh) and south (Lampungs); throughout Borneo except the extreme north-east (Kudat District) and south-east (particularly near Pleihari in the rain shadow of the Meratus mountains); down the eastern side of the Philippine archipelago from Cagayan Province of Luzon and including most of Mindanao; and throughout lowland New Guinea and adjacent islands immediately to the west but excluding the region around Port Moresby in the south-east and a belt in the south extending from the Fly River into West Irian (Okaba to Merauke and Wassi Kussa). Within this region there is still considerable variation in mean annual rainfall and its seasonality, and in some areas where seasonality is relatively pronounced the dipterocarp flora becomes somewhat impoverished and species of the seasonal evergreen forest become more abundant. Such is the case in eastern Luzon, much of eastern New Guinea, eastern Borneo, much of Sumatra, Pattani in Thailand and northern Malaya including Perak, Kedah, part of Kelantan and to a lesser extent Trengganu and northern Pahang and Selangor. There is also evidence of recent changes in the boundaries of these forests: this may explain the presence of *Shorea leprosula* and *S. parvifolia* in an outlier at Trang in Peninsular Thailand, for instance.

*Role in succession.* It can be readily explained why dipterocarps are generally absent in secondary forest in this zone, and why they take so very long to reinvade devastated land, for their very limited means of seed dispersal combines with their sensitivity to water stress at germination and early establishment to make them particularly unsuitable as colonisers. Colonisation is only known to occur successfully therefore on clay soils with a high water retaining capacity in moist hilly districts and periodically inundated alluvium (ASHTON, 1964). It is more difficult to understand why this should not be true in the seasonal evergreen zone: here not only is *Dipterocarpus alatus* a rapid coloniser of alluvium, but such species as *Anisoptera costata* and *A. thurifera* (R. JOHNS, unpubl.)



Fig. 6. Hill dipterocarp forest of *Shorea curtisii* DYER ex KING, *séraya*, at c. 900 m alt., in Malaya (Photogr. WYATT-SMITH).



actually increase in density in secondary forest. Germination studies of these species as well as those of the Dry Dipterocarp forests would be rewarding.

*Edaphic conditions.* As the role of the family differs entirely between the forests of the Sunda and New Guinea non-seasonal zones the two must be considered separately. In western Malesia (Sumatra, Malaya, Borneo and Philippines) *Dipterocarpaceae* dominate the forests on well-drained yellow and red soils below 1300 m; these forests have hence been termed Mixed Dipterocarp forest by me (1964). SYMINGTON (1943) had recognised that the coastal hills of Malaya bore a characteristic forest flora, many elements of which, such as *Shorea curtisii*, *S. ovata*, *S. glauca*, *Vatica mangachapoi*, *Hopea beccariana*, *Dipterocarpus fagineus* and *Anisoptera curtisii* also occur along inland ridges. Fig. 6. BURGESS has demonstrated that the two habitats share a pronounced tendency to prolonged periods of water stress differing from those of the semi-evergreen zone in their unpredictability.

Increased water stress may explain why trees isolated by felling operations so frequently die; death of mature trees in undisturbed forest on account of water stress has never been recorded. I observed (1968) the sensitivity of *Hopea enicosanthoides* to prolonged submergence however. I had earlier (1964) demonstrated that Mixed Dipterocarp forest on sedimentary rocks in Brunei varied considerably in structure and floristics and correlated this variation largely to environmental features that influence water status, including physiography and physical characteristics of the soil; in my view nutrient status had little part to play in differentiating the vegetation. I demonstrated a distinct floristic connection between the forests on very well drained yellow podsolic sands in Brunei and those of the Malayan coastal hills, whereas the inland lowland Malayan element was confined to clay soils, especially on broad low ridges.

My views were in conflict with those of SYMINGTON and WYATT-SMITH who found no consistent relationship between soils and forest variation in inland lowland Malaya. POORE (1968) confirmed their views in an intensive study of a limited area in Pahang, where he deduced that the commoner species had wide edaphic amplitudes and were interchangeable so that, once seedlings had become established, a process in which chance must play a large part, "possession is nine points of the law".

The conflict is largely resolved, and the lowland ecological range of the family more precisely defined, in my recent work. I have shown that these lowland forests can be categorised into two main groups: In one soil phosphorus levels in particular, and other elements to a lesser extent, are relatively high and the forests are floristically rather uniform; in the other phosphorus levels are low and the forests exhibit great variation which can be correlated with nutrient status (AUSTIN, ASHTON & GREIG-SMITH, 1972). These observations are consistent with the theory that dipterocarps are mycorrhizal. As soils with low nutrient levels are often those which are most freely drained, water stress and limiting nutrient levels tend to go hand in hand but it is apparent, as this is not always the case, that both factors have an important part to play in dipterocarp ecology. The low fertility soils are principally those of the Tertiary and Quaternary sands at the margins of the Sundaland continent, where the sediments have become impoverished by successive erosion and deposition cycles since the Cretaceous; the Malayan Peninsula hardly possesses rocks younger than the Cretaceous and this ancient land surface is covered by deep soils of moderate fertility, though even here a subtle correlation does in fact exist between physiographic and floristic variation (ASHTON, 1976).

I have (1964) described the floristic and structural role of the family in the lowland forests. They reach their zenith both in numbers of species and individuals on deep well drained yellow/red soils of intermediate fertility, where nutrient levels are apparently limiting but not severely so. In Heath forest on podsols dipterocarp diversity is much reduced and in peat swamp forests yet more so; in both single dominant species are frequent. Examples are *Shorea materialis* in Heath forest and *Shorea albida*, *S. balangeran* and *Dryobalanops rappa* in Bornean peat swamp forests. In the latter forests diversity increases from the centres of the domed oligotrophic bogs outwards as soil fertility increases, several species (*Shorea inaequilateralis*, *S. pachyphylla*, *S. platycarpa*, *S. teysmanniana*, *S. uliginosa*, and *Dipterocarpus coriaceus*) being found exclusively in the Mixed Peat Swamp forests of the margins (ANDERSON, 1963). Other species occur in both peat swamps and Heath forest, while some 30 species are almost entirely confined to Heath forest; the ecotone between Heath and Mixed Dipterocarp forest on yellow podsolic sandy soils is ill defined and many species are common to both. More surprising is the marked decrease in species diversity on well drained soils of highest



Fig. 7. Even-aged stand of mixed dipterocarp forest, with *e.g.* *Shorea almon* Foxw. and *S. polysperma* (BLCO) MERR. abundant in the canopy, recovering from total destruction due to a cyclone in 1944, in 1975. Note the pyramidal, monopodial juvenile crowns. Mindanao, Suriago del Norte (Photogr. ASHTON).



fertility; I have shown (1964) that there was a decrease in diversity on calcareous shales in comparison to sandstones, most marked on the shallow skeletal soils on the narrow ridges and steep slopes of the youthful N.E. Bornean physiography. Unpublished analyses from Sarawak show a further decrease in both density and diversity on deep fertile soils; here gregariousness also increases. The gregarious stands of *Shorea retinodes* on the slopes of the Barisan range, where soils have been much affected by Quaternary volcanic activity and landslips remain common, may be a comparable example. In some cases the explanation may partially lie in the isolation of these small distinctive habitats of geologically recent origin, preventing the rapid build-up of diversity. Fig. 7.

Low diversity and the presence of gregarious species also characterise excessively dry habitats in the non-seasonal zone. Thus *Shorea gratissima* is confined to and gregarious on rocky headlands; and *Dryobalanops aromatica* forms pure stands on coarse gravelly soils and yellow podsollic sands in Atjeh and Malaya.

The limestone dipterocarp flora is poor; though no species is known to be gregarious in the non-seasonal zone *Hopea ferrea* is so on the rocky hills of the Langkawi Is. No species appears to be confined to limestone, but species sometimes found on it include *Cotylelobium malayanum*, *Hopea aptera*, *H. billitonensis*, *H. cernua*, *H. dasyrrachis*, *Shorea guiso*, *S. havilandii*. In the seasonal north-west of the Malay Peninsula *Shorea siamensis* and *S. roxburghii* occur on it; and further north outside Malesia, where mineral soils accumulate over the rock, a wide range of dipterocarps may grow. Similarly, the dipterocarp flora on the soft coral limestones of eastern Mindanao does not seem to differ from that on other substrates, and their roots penetrate the soft rock itself.

The intrinsically unstable and specialised habitat of river banks also carries a characteristic dipterocarp flora of some 20 spp. in western Malesia. Most species are widespread but some (e.g. *Dipterocarpus oblongifolius*, *Hopea centipeda*) occur only on the rocky banks of rapid inland rivers, whereas others (e.g. *Vatica venulosa*, *Shorea seminis*) equally prefer alluvium along meandering rivers of the plains.

The many similarities between the ecology of the dipterocarps and the undoubtedly ectotrophic mycorrhizal *Fagaceae*, which assume dominance at high altitudes, is noteworthy.

Summarising: Comparatively few species are restricted to one vegetation type or one substratum or type of bedrock. For example, many *Vaticas* occur in alluvial forest and near rivers, but seldom exclusively so, and occur also on the hills, though they may be more common in the former habitat. *Hopea pentanervia* occurs on mixed peat swamp over sand, podsols and cuestas, plateaus and terraces near present or Pleistocene coastlines, and on ultrabasic rocks in N. Sabah; *Shorea polyandra* is found on fertile, clay-rich soils on calcareous shales, igneous and volcanic rocks; *Shorea scabrida* is found in freshwater swamp forest, on shallow peat overlying sand, and on skeletal soils on ridges and plateaus, in Heath forest and in Mixed Dipterocarp forest. This apparent diversity of habitats occupied nevertheless frequently conceals a common and sometimes rather specific edaphic range.

Others are more clearly confined to certain edaphic habitats and some of these are cursorily listed here:

*Heath (kerangas) forest on podsols*: *Cotylelobium burckii*, *C. malayanum*, *Dipterocarpus borneensis*, *Dryobalanops fusca*, *Hopea kerangasensis*, *H. micrantha*, *H. pterygota*, *H. vacciniifolia*, *Shorea coriacea*, *S. in duplicata*, *S. materialis*, *S. pallidifolia*, *S. retusa*, *S. revoluta*, *S. venulosa*, *Vatica coriacea*, *V. parvifolia*.

*On sandy soil* the following are frequently recorded: *Anisoptera grossivenia*, *A. reticulata*, *Cotylelobium melanoxylon*, *Dipterocarpus globosus*, *D. rigidus*, *D. sarawakensis*, *Dryobalanops aromatica*, *Hopea beccariana*, *H. coriacea*, *H. treubii*, *H. vesquei*, *Shorea acuta*, *S. crassa*, *S. dealbata*, *S. falcifera*, *S. flemmichii*, *S. geniculata*, *S. ladiana*, *S. laxa*, *S. rubella*, *S. rugosa*, *S. scabrida*, *S. stenoptera*, *Upuna borneensis*, *Vatica borneensis*, and *V. oblongifolia* spp. *crassilobata* and *elliptifolia*.

*In peat swamps* the following species are characteristic, some being gregarious there: *Anisoptera marginata*, *Dipterocarpus coriaceus*, *Dryobalanops rappa*, *Shorea albida* (also in Heath forest), *S. balangeran* (also in Heath forest), *S. foraminifera*, *S. inaequilateralis*, *S. macrantha*, *S. pachyphylla*, *S. platycarpa*, *S. teysmanniana*, and *S. uliginosa*. Fig. 8, 96.

On ultrabasic soils the following are regularly recorded, but only the last is confined to them:



Fig. 8. Stands of large trees in peat-swamp of *Shorea albida* SYM., *alan*; road tracé to oil well in Seria, Brunei, at 5 m alt. (Photogr. ASHTON, 1960).



*Dipterocarpus geniculatus* ssp. *grandis*, *D. ochraceus*, *Hopea pentanervia*, *Shorea coriacea*, *S. tenuiramulosa*.

It will be noted that all examples given occur in Borneo and many are endemic there; this reflects the unusual habitat diversity as well as infertility of that island.

*Altitude.* The altitudinal limits of *Dipterocarpaceae* in the non-seasonal zone experience mean minimum monthly temperatures comparable to those at the northern margin of the family range at 22° N, in Yunnan, Kwangsi, S. Kwantung, and Hainan at c. 15° C. In areas of shallow soils, often of low base status, such as those derived from the sedimentary rocks at the margin of the Sunda shelf area in N.W. Borneo, altitudinal zonation of vegetation is obscured by variation in relation to soils except at the extreme altitudinal limits and on isolated summits. In Malaya such zonation is clearer, though the ecological relationship between the ridge and coastal hill flora has already been described. The increase in raw humus accumulation above 1000 m is associated with the marked affinity between the dipterocarp flora of the hill ridges and lowland podsolic soils. SYMINGTON (1943) summarised the altitudinal zonation of dipterocarp species in Malaya: He recognised a Lowland Dipterocarp forest zone below 300 m, with the coastal hills as a separate category, the former with 108 spp., the latter with 27 of which 8 are shared; between 300–800 m are Hill Dipterocarp forests with 49 spp., and between 800–1300 m (the altitudinal limit of dipterocarps in Malaya) are Upper Dipterocarp forests with 15 spp. Within the two hill types there are 7 exclusively hill species; of the rest 15 are exclusively coastal in the lowlands and of these 5 occur also in the Upper Dipterocarp forests; the remaining 35 occur in Lowland Dipterocarp forests generally, though of these but 4 are found in the upper zone. The existence of a small group of apparently obligatory hill species is not confined to Malaya; some are widespread in western Malesia, *Dipterocarpus retusus* extending eastwards to Sumbawa, while in Borneo there are a further 10 endemic montane taxa. A few ascend above 1000 m, for example to 1200 m: *Shorea carapae*, *S. revoluta*, *Vatica odorata* ssp. *mindanaensis*; to 1300–1350 m: *Shorea beccariana*, *S. flaviflora*, *S. platyclados*, *S. rubra*, *Vatica heteroptera*; to 1400 m: *Shorea longisperma*, *Vatica dulitensis*; to 1500 m: *Shorea monticola*, *S. ovata*, *Vatica oblongifolia* ssp. *selakoensis*; to 1600 m: *Shorea venulosa*; to 1650 m: *Hopea cernua*; to 1700 m: *Vatica granulata* ssp. *sabuensis*; to 1800 m: *Shorea platyclados* (Atjeh).

At their upper limits the dipterocarp forests give place to oak-laurel forests in Malesia; it is noteworthy that in Ceylon, where the *Fagaceae*, which share with *Dipterocarpaceae* gregariousness and well developed ectotrophic mycorrhizal associations but which become dominant above 1300 m, are absent, 9 exclusively montane species of the endemic taxa *Shorea* sect. *Doona* and *Stemonoporus* dominate the hill forests of the south-west up to 1700 m (ASHTON, 1972, 1977).

*Synopsis: Role of dipterocarps in the frame of the forest.* At their edaphic optimum in the lowlands dipterocarps may comprise more than 80% of all emergent individuals in the forest, and up to 40% of understorey trees. Under conditions of increasing proneness to aseasional drought the emergent stratum becomes less dense, the understorey more so, and dipterocarps decrease their representation in both except where gregarious species occur. Under the most mesic conditions the emergent canopy becomes so dense as to be continuous, and the understorey consequently becomes diffuse in the low light intensity; here total dipterocarp density as well as relative density is reduced.

In the non-seasonal evergreen forests of New Guinea dipterocarps play an altogether subsidiary role. Only 14 spp. are so far known from these vast forests; 11 are endemic to New Guinea and adjacent islands, and 9 are confined to local areas within the island. One species of *Anisoptera*, one of *Vatica* and 12 of *Hopea* are represented. Only *Anisoptera thurifera* is truly emergent, and gregarious stands often give a distinctive profile to the steep-sided crests. Several *Hopeas*, among them *H. forbesii* and *H. iriana*, are canopy species, as is *Vatica rassak* in the more seasonal areas. The family as a whole shows a distinct though not exclusive preference for ridge tops, noticeable (though less markedly so) on the similarly youthful physiography of much of Borneo.

Single species as a rule individually merely play a minor part as contributors with many others to the overall role of the family. Gregarious or semi-gregarious populations occasionally occur in many, perhaps most, species including those of the understorey and are probably usually attributable to chance favourable conditions at the time of establishment. In Malesia they are habitual only in the species of the Dry Deciduous Dipterocarp (fire climax) forests, notably *Dipterocarpus obtusifolius*, and to a lesser extent those of seasonal evergreen forests including



Fig. 9. Trunk-base of a colossal specimen of *Shorea superba* SYM. on basalt, half a mile south of Quoin Hill, Balong area, Tawau, Sabah, forest guard KAPIS BIN SISIRON at point of measurement: total height of tree 75 m, clear bole 27 m, girth at 4 m above ground  $9\frac{1}{2}$  m = 3 m diam. (Photogr. G. H. S. WOOD).

*Anisoptera costata*, *A. thurifera*, *Dipterocarpus costatus*, *D. gracilis*, *D. grandiflorus*, *D. kerrii*, *Hopea ferrea*, *H. forbesii*, *H. glabrifolia*, *H. gregaria*, *H. pierrei*, *Shorea guiso*, *S. hypochra*, *S. roxburghii*, *S. selanica*, *Vatica cinerea* and *V. rassak* on the one hand: — and on the other in species of limiting soil conditions such as *Dipterocarpus elongatus*, *D. oblongifolius*, *Hopea fluvialis*, *H. odorata*, *Shorea seminis*, *S. sumatrana*, *Vatica pauciflora*, *V. rassak* and *V. umbonata* on river banks and flood plains. — *Dryobalanops fusca*, *D. rappa*, *Shorea albida*, *S. balangeran* and to a small extent *Anisoptera marginata*, *Shorea inaequilateralis*, *S. platycarpa*, *S. teysmanniana* and *S. uliginosa* in peat swamps. — and *Anisoptera marginata*, *Cotylelobium burckii*, *C. malayanum*, *Dipterocarpus borneensis*, *Dryobalanops fusca*, *Shorea materialis* and sometimes others in Heath forest. Several factors, including chance, may have played a part in the origin and maintenance of the extensive gregarious stands of *Dryobalanops aromatica* (see VAN SLOOTEN, 1932; LEE, 1967) and *Shorea retinodes* (VAN SLOOTEN, 1949).



*Literature:* ANDERSON, Gard. Bull. Sing. 20 (1963) 131; ASHTON, Oxf. For. Mem. 23 (1964); Man. Dipt. Brun. Suppl. (1968) 51; Biol. J. Linn. Soc. 1 (1969) 155; Proc. 2nd Aberdeen-Hull Symp. Mal. Ecol. (1972) 35; Blumea 20 (1972) 357; Mal. For. 39 (1976) 56; Rev. Handb. Fl. Ceylon 1, 2 (1977) 166; ASHTON *et al.* (1979) in press; AUSTIN, ASHTON & GREIG-SMITH, J. Ecol. 60 (1972) 305; BURGESS, Mal. For. 32 (1969) 438; Mal. For. 35 (1972) 103; BURKILL, J. As. Soc. Str. Br. 86 (1922) 276, 281; CHAMPION, Ind. For. Rec. Bot. 1 (1936); CHAN, Mal. For. 43 (1980) 438; CHAN & APPANAH, Mal. For. 43 (1980) 132; COCKBURN, Mal. For. 38 (1975) 160; DALJEET SINGH, Mal. For. 37 (1974) 24; GUPTA, Ind. For. 62 (1936) 525; *ibid.* 63 (1937) 734; *ibid.* 64 (1938) 15; HONG, Mal. For. 42 (1979) 280; KENWORTHY, Mal. Nat. J. 22 (1969) 129; Proc. 1st Aberdeen-Hull Symp. Mal. Ecol. (1971) 49; KOCHUMMEN, Mal. For. 24 (1961) 236; LEE, Ph.D. Thesis, Univ. Malaya (1967); McCURE, Mal. For. 29 (1966) 192; MIDWAY, Biol. J. Linn. Soc. 4 (1972) 117; MERRILL, Philip. J. Sc. 23 (1923) 18; NG, Mal. For. 19 (1966) 290; Nature Malaysiana 3, n. 1 (1978) 12, col. phot.; PALMER, Mal. For. 42 (1979) 74; POORE, J. Ecol. 56 (1968) 143; RIDLEY, Disp. Pl. (1930) 51; SASAH, TAN & ZULFAH, Mal. For. 42 (1979) 38; VAN SLOOTEN, Bull. Jard. Bot. Btzg III, 12 (1932) 7; *ibid.* III, 18 (1949) 263; Reinwardtia 2 (1952) 1; SMITH, Ann. Perad. 4 (1909) 229; SMYTHIES, Sarawak Gaz. 84 (1958) n. 1206, p. 146; STAMP, The Vegetation of Burma, Calcutta (1925); SYMINGTON, Mal. For. Rec. 16 (1943); TANG, Mal. For. 34 (1971) 84; *ibid.* 41 (1978) 294; TANG & TAMARI, Mal. For. 36 (1973) 38; WEBBER, Mal. For. 3 (1934) 18; WOOD, Mal. For. 19 (1956) 193; WYATT-SMITH, Mal. Nat. J. 7 (1952) 45, 91; *ibid.* 8 (1953) 52; Mal. For. 17 (1954) 83; Mal. For. Rec. 23 (1963); WYCHERLEY, Micronesica 9 (1973) 75.

*Morphology. Habit.* See Fig. 9, 21, 25, 32, 51, 53, 55, 80, 111, 112, 117. The bole can be cylindrical in cross-section, or fluted or ribbed, and is usually buttressed. See Fig. 29, 52, 59, 81. The buttresses can be small or large, thin with a sharp edge as in *Shorea* sect. *Shorea* generally, or thick with a rounded edge; the edge, from the soil surface to the apex where the buttresses merge into the bole, is usually concave, but is sometimes straight or convex; the buttresses can terminate more or less abruptly at apex and base, or continue as ribs up the bole as in *Anisoptera* sect. *Anisoptera* or superficial roots over the ground. Flying buttresses are convex-edged buttresses originating from the bole above the soil surface, and are differentiated from the stilt roots by being flat, therefore elongate in cross-section, as opposed to being terete or spherical in cross-section; stilt roots can be adventitious to the buttresses or arise from the bole. Flying buttresses and stilt roots are a particular feature of *Hopea*, and are found at least occasionally in a majority of species with the exception of those in sect. *subsect. Hopea*. Fig. 67, 71.

In the seasonal parts of S.E. Asia (Thailand, *etc.*) various species of *Dipterocarpaceae* have a capacity for suckering and produce new stems from trunk-bases after cutting. However, the Malesian rain-forest species generally lack this capacity and regenerate merely from seed.

The mode of branching, and the leaf arrangement, changes ontogenetically. The seedling dipterocarp, after production of one or more pairs of opposite leaves, sends up a stem with spirally arranged leaves. From the axils of these leaves arise the lateral branches; the leaves on the branches are generally arranged distichously, consequently the branchlets are also alternately arranged and the branches occupy one plane (plagiotropy), ascending, descending, or horizontal. The sapling leader, or stem apex, grows continually at first, but soon adopts resting periods, growth proceeding in flushes that are not necessarily seasonal at this stage though often synchronised among members of a clump. The internodes are frequently longer towards the beginning of the growth flush than towards the end, so that the stem leaves in some species, particularly *Hopea* sect. *Dryobalanoides*, are largely bunched at the end of each growth stage of the leader; consequently the branches appear to arise in whorls and the sapling and pole sized tree assumes a 'pagoda shape' (CORNER, 1940); each flush of growth by the leader is coordinated with the sprouting of some of the axillary buds of the previous flush to form new lateral branches.

Young dipterocarps therefore conform either to Massart's model, that is, with rhythmic growth and branching, or approach Roux's, with continuous growth (HALLÉ, OLDEMAN & TOMLINSON, 1978).

The leaders have spiral leaf arrangement; if a leader dies or its growth is otherwise arrested at this stage, new leaders emerge not from axillary but from tiny subsidiary buds (NG, 1976); whether a single leader eventually achieves dominance over others varies with the species.

If the tree remains small, and never reaches the forest canopy, as in many *Hopea* species, it

frequently remains monopodial with this form of branching, and the crown remains lanceolate or conical. Fig. 7, 36. If the leader reaches the canopy the subsequent lateral branching generally become orthotropic, apical dominance is lost, the earlier plagiotropic branches die and are lost and a hemispherical or dome-shaped crown is formed. Fig. 1.

Alternatively, plagiotropic branches become orthotropic towards their tips (HALLÉ, *in pass.*). Many *Vatica* species, however, which never become tall enough to reach the forest canopy, become more or less sympodially branched and develop an irregular oblong crown; while *Parashorea macrophylla*, and some members of the *Shorea sections Mutica* and *Anthoshorea* remain monopodial for some time after they have emerged above the canopy and reached full height, and may even send up further vertical leaders, apparently from axillary buds from the plagiotropic side-branches. In most species with an emergent sympodial crown the leaves are spirally arranged on the branchlets, but in species that tend to branch low, such as the riverside species, those species in which some or all the branches become horizontal or pendant towards the apices, and the species with compressed twigs, the leaf arrangement is frequently or always alternate. If the branches are many and radiate from the bole apex, as in many emergent *Hopea* species, the crown of emergent species takes on an evenly hemispherical appearance. If the main branches are few and large but much branched towards the apices, the branchlets become bunched towards the ends of the large branches into more or less hemispherical groups and the crown assumes the appearance of a cauliflower head. If the twigs are stout and the leaves large the crown shape is uneven and the leaves tend not to be confined to the perimeter of the crown. Rarely, the branches become pendent at the apices and the crown becomes 'weeping' (e.g. *Shorea inaequilateralis*, *S. quadrinervis*). Fig. 111.

According to HALLÉ, OLDEMAN & TOMLINSON (1978) who have classified tree architecture into a series of 'models', trees do not change from one model to another during life. They placed the species of *Dipterocarpus* and *Shorea* they examined in Massart's model in which the trunk is orthotropic, the branches plagiotropic and in false whorls through rhythmic growth, and the position of flowers various; and in Roux's, which differs from Massart's in that trunk growth is continuous. From the foregoing description it would appear that the model may be mutable in dipterocarps, for growth eventually always becomes rhythmic though it may not start thus, and because in most emergent species successive branches become increasingly orthotropic with a change from alternate to spiral leaf arrangement. This change in branching pattern would not imply a change in model were such orthotropic branches arising through reiteration, that is from supra-axillary buds following damage to the leader; but this does not seem to be the case.

*Bark.* Fig. 9, 22, 24, 31, 45, 52, 69, 102, 113, 114. THORENAAR (1926) first systematically examined bark morphology in the family; SYMINGTON (1943) used bark characters extensively for field diagnosis. WHITMORE (1962) described how weathering processes and tangential strain during growth together act in conjunction with the growth of secondary phloem, expansion tissue developed from phloem rays, phloem proliferation tissue developed from the phloem parenchyma, and the periderms (each of which are laid down in several ways), to produce surface features distinctive of both species and higher taxa; these features change ontogenetically from an initial smooth surface. He thus rationalised bark description, which essentially comprises the surface pattern (the visual summation of surface configurations) and the slash appearance (the visual summation of the appearance of the inner and outer bark in oblique transverse section). Various degrees and types of fissuring develop through tangential strain, and of flaking on account of the disposition of the periderms. In a few taxa (e.g. most *Vatica*, and *Shorea sect. Pachycarpae*) the bark remains smooth; in others (e.g. *Anisoptera*, *Dipterocarpus*, *Shorea sect. Shorea* and *sect. Richetioides*) it almost always becomes distinctively flaky, while in yet others (e.g. *Shorea subsect. Mutica*) it becomes distinctively fissured. In one known instance (fissured-bark *Hopeas*) a distinctive bark configuration has no apparent taxonomic significance above the species level, and is not indeed even consistently developed within the species. Seven distinct bark types, in three groups differing in the amount of expansion tissue, were recognised; within each a number of categories exhibiting lesser structural differences were defined as bark manifestations; it is these that characterise taxa at generic and sectional level. In this account bark characters are summarised in generic and sectional descriptions where appropriate, but have been omitted from species descriptions; reliable bark descriptions of species can be found by reference to SYMINGTON and WHITMORE and also ASHTON (1964, 1968). In particular they contribute important definitive characters for the sections of *Shorea*.



Resin exudations from wounds in living bark and wood also differ in frequency, rate and mode of crystallisation, translucency and colour and sometimes form useful subsidiary characters for identification.

**Roots.** Fig. 10. Malesian dipterocarps lack taproots, though they are well known in *Shorea robusta* GAERTN. f., and reported from *Hopea parviflora* BEDD., both of India. The laterals are of two categories; an extensive branching system of superficial roots extending from the buttresses and proliferating into a dense mat of fine roots, found by SINGH (1966) and HONG (1979) in many Malayan species, and BAYLIS (with the author, unpubl.) in *Hopea iriana*, to be ensheathed in a dense ectotrophic mycorrhizal mantle; and a diffuse coarse sparsely branching system, consisting of lines of carrot-like 'sinkers' descending vertically from below the buttresses, sometimes also with obliquely descending branches from the principal superficial roots. In acid peaty soils the former are very well developed and the latter few; in fertile soils the converse; in deep fertile soils the latter can penetrate at least 5 m beneath the surface. ANDERSON (1961) has described the extremely specialised roots of the peat swamp species *Shorea albida* SYM. Here the buttresses give off a dense mat of roots c. 30 cm above the permanent water table, on which litter falls and raw humus accumulates; beneath there is a discontinuous cavity into which clumsy walkers easily fall; many stout roots descend from the lower surface of the main superficial roots through this cavity into the waterlogged peat substrate, anchoring the tree.

NG (1975) has described the occurrence in nature of root grafting between species in several genera.

**Buds.** The dipterocarp resting bud is clad in appressed scales. Axillary buds are minute, except prior to shoot expansion, in most species, but terminal buds are evident in *Parashorea*, *Upuna* and *Anisoptera*, in most *Shorea* and in some species of other genera, while in *Dipterocarpus* they are generally large, sometimes resinous, and their shape and indumentum provide valuable species characters.

Parts of stem or leaf are frequently distorted in the young shoot, especially of saplings and young trees, by certain wasps into distinct galls (CORNER, 1963; ANTHONY, 1973, 1974) which may be globose and spinous, variously elongate and covered in umbriate fish-like scales, or merely simple swellings. These galls appear to have no taxonomic value, and at least three forms are found in *Shorea ovalis*.

**Twigs.** In most genera the twig surface, its diameter near the apex, its shape in cross-section, and the shape and size of the stipule scars can be specifically diagnostic.

**Leaf.** Though the stipules are frequently fugaceous, in some species (especially in *Dipterocarpus* and *Hopea subsect. Pierrea*) they are relatively persistent and the size and shape can be diagnostic. The size and shape of blade and petiole, and the number of nerves, is usually specifically diagnostic. The nerves are vertically transcurrent, bounded dorsiventrally by sclerenchyma to the epidermis. The type of nervation is diagnostic for some genera and sections. If the nerves are very many, slender, close, of equal length and straight to the margin with no discernable tertiaries, they are termed 'parallel' (*Dryobalanops*); if as above, but unequal in length, and curving before the margin, they are 'dryobalanoid' (some *Hopeas*); if the latter have distinct scalariform or reticulate tertiaries and the nerves are very unequal and divisible into main nerves and shorter intermediate secondaries they are termed 'subdryobalanoid' (some *Hopeas*). In *Cotylelobium* and *Anisoptera* the nerves curve distally and unite forming a looped intramarginal nerve. Tertiary nerves of penninerved species are generally scalariform but in most *Vatica*, *Anisoptera*, *Cotylelobium* and *Shorea sect. Richetioides*, and in a few other species, they are reticulate.

**Domatia** occur in various species of the genera *Vatica*, *Shorea* and *Hopea* (Fig. 64a, 73a); they are common in *Hopea* (cf. VAN SLOOTEN, 1941) and the saplings of *Shorea* in particular. They are often diagnostic for a species, and are a product of the plant itself. Domatia are usually confined to the axils of a few nerves towards the base of the midrib, but can extend the whole length, especially in saplings; in *Shorea platycarpa* and some others they form a continuous series flanking the midrib, while in young trees of *Shorea leprosula* they similarly flank the main nerves as well. Most frequently they are pore-like, sometimes hairy, sometimes with the cavity enlarged, pale and stoutly rimmed (e.g. *Hopea nutans*, *Shorea parvifolia*); sometimes they are scale-like as in *Shorea platycarpa* and *S. leprosula*. Young leaves are usually suffused with magenta anthocyanin pigments; in *Shorea sect. Richetioides* they are usually violet or dark crimson.



Fig. 10. Structure of root-system of *Shorea falcifera* DYER ex BRANDIS with dug-out profile beneath it, Kuantan, E. Malaya (Photogr. ASHTON, Sept. 1970).



Extrafloral nectaries occur in many genera on the leaf upper-surface, often near the margins and between vein divisions.

The *petiole* in mature leaves is thickened towards the apex into an umbo, often shrinking in the drying process. As an exception the blade is peltate in *Shorea peltata* and leaves of young specimens in *Shorea chaiana*, *S. laxa*, *S. polyandra* and some others. The umbo is obscure in *Dryobalanops* and some *Hopea* species.

*Epidermis and indumentum.* GUÉRIN (1907) examined the leaf and twig epidermis anatomically in many species and stated that from this alone most genera, and sometimes even species, can be distinguished. I found that epidermal characters rarely provided evidence for species diagnosis except where taxa were easily differentiated macroscopically: the size of epidermal cells, the thickness of the walls and the position of domatia relative to the surface as well as the indumentum varies more according to the part of the tree from which the leaf originates, and the age of the plant than between closely related species. Thus I confirmed GUÉRIN's conclusions that genera can sometimes be identified anatomically, but the method was not valuable at the species level. GUÉRIN also described long-stalked glandular hairs with unicellular heads on certain *Stemonoporus* species: they appear identical to the glandular hairs that densely cover the young parts and inflorescence of *Upuna*, and were also found, according to SYMINGTON (1941), among the indumental hairs of *Monotes*; RAO (1953) found such hairs on the calyx of *Shorea roxburghii* G. DON. Short-stalked glandular hairs with a multicellular head are a general feature common to most, if not all, *Dipterocarpaceae*; the base of the stalk is typically sunken in an epidermal pit. A dense indumentum of peltate emarginate scales occurs in *Anisoptera*, imparting a characteristic colour to the lamina undersurface and twigs. The number of cells in the head often varies with the age of the plant and therefore is of little value for diagnosis: thus in *Anisoptera marginata* they are at first 4-celled, later 8-celled.

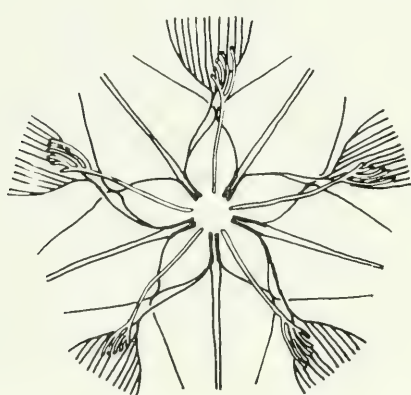
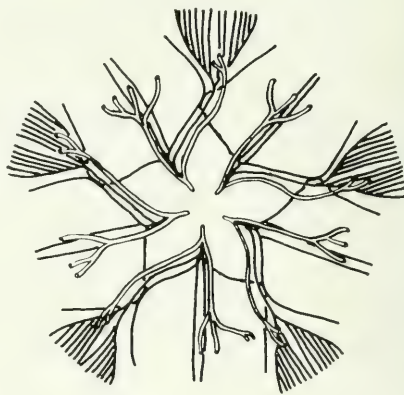
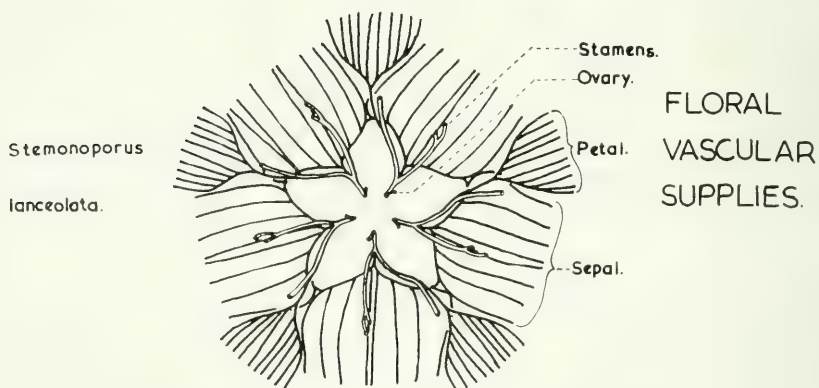
Tomenta of evenly distributed unicellular hairs are present in nearly all species, though fugaceous in many. Unicellular papillae occur on the ovary, stylopodium or connectival appendage of some *Shorea* and *Hopea* species. In some *Shorea* species there is an indumentum of broadly lobed wax secretions; in *Hopea* and some *Shoreas* this covering is more sparse and with slender acute lobes. The macroscopic appearance is similar, except in colour, in all species; it is usually persistent, not easily rubbing off.

Hairs arranged in fascicles are almost universal among the *Dipterocarpaceae* though often fugaceous. The tufts may be short or long, sparsely or densely distributed; they may be of uniform length, producing an 'even' tomentum, or of two or more different sizes, producing a 'scabrid' tomentum. In all species tomenta tend to become shorter and sparser towards the margins and apices of organs; they are usually longest and most persistent on the leaf bud, and become successively shorter, sparser, and less persistent on twigs, petiole, leaf midrib below, primary nerves to tertiary nerves, and finally on the lamina surface itself. Thus many species possess persistently tomentose midribs and glabrescent nerves, but never *vice versa*. In some *Dipterocarpus* this trend is accompanied by a reduction in the bristles, while on the tertiary nerves the clusters are represented by a single long bristle and a basal cushion representing the greatly shortened other members.

Hairs are most persistent on the inflorescence, secondly on the bud scales. Though the tomentum tends to be longer, sparser, and more persistent in young trees, the colour and appearance furnishes important diagnostic characters.

*Inflorescence.* The typical form is a semi-pendent bracteate, apical, axillary or occasionally ramiflorous panicle once (if axillary) or twice (if terminal) branched in one plane with the flowers secund, shortly pedicellate and nodding, developed in acropetal succession. *Vateria*, *Upuna* and some *Vatica* possess cymes and the flowers are not secund; in *Vatica* the condition is clearly derived. In *Dipterocarpus* generally, and occasionally in other genera, the inflorescence is few-flowered and hardly or not branched. Most species bear apical as well as axillary inflorescences together on the same twig; a few rarely or never develop terminal inflorescences, and of these several *Hopea* and *Vatica* (e.g. *V. sarawakensis*) are strictly ramiflorous while some other *Vatica* (e.g. *V. venulosa*) and *Shorea* (e.g. *S. stenoptera*, *S. hemsleyana*) approach this condition.

*Flowers.* The centrifugal stamens originate from a number of common bundles independent from the gynoecium. Fig. 11. The gynoecium bundles break away from the common supply with the stamens before the stamen supply begins to branch. In all genera but *Upuna* and some *Stemonoporus*

*Upuna borneensis**Anisoptera grossivenia**Stemonoporus**lanceolata.*

Stamens.

Ovary.

Petal.

Sepal.

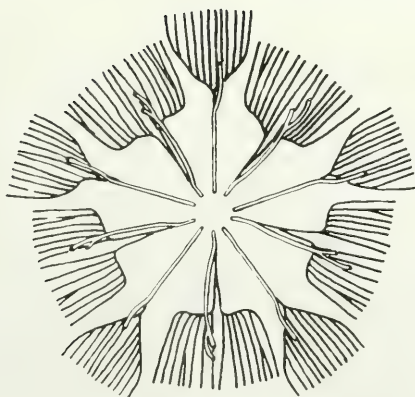
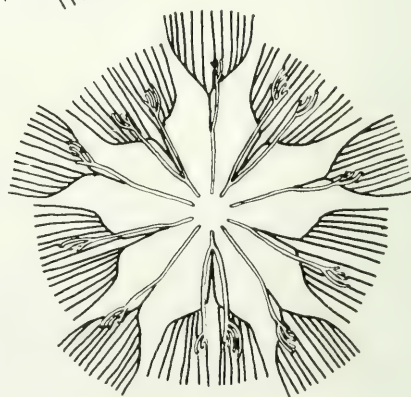
FLORAL  
VASCULAR  
SUPPLIES.*Shorea scaberrima**Shorea havilandii*

Fig. 11. Scheme of floral vascular supplies in five dipterocarp species.



(*Monoporandra*) of Ceylon the number of primary stamen bundles is 10. In *Upuna* they are independent of the perianth supply and continue between the perianth bundles in the pedicel; in other genera the 10 stamen bundles are associated with the 10 perianth members, though in some *Shorea* (e.g. *S. geniculata*) they appear not to unite within the length of the receptacle and pedicel. In all species where the number of stamens is more than 10 the stamen fascicles originating from the calyx supply are larger than those originating from the petals. In *Shorea*, *Hopea*, *Vatica* and *Cotylelobium* the petal and sepal bundles, together with the staminal bundles originating from them, are independent. *Upuna*, *Anisoptera*, *Vateria*, *Stemonoporus* and *Dipterocarpus* are alike in that a single lateral branch arises constantly from the left or right of each sepal bundle which supplies the petals; the staminal bundles from the sepal supply originate above this bifurcation.

In a recent paper C. WOON & H. KENG (1979) gave details with very numerous figures of the stamens in *Dipterocarpaceae*.

Flowers are usually small, except in *Dipterocarpus* and *Vateria*. The shape and size of the bud and the size and shape of the perianth members is diagnostic for some sections of *Shorea*. The number of stamens in species with less than 20 is constant in normal flowers; in those with more than 20 the number varies about a mean, but provides a useful specific diagnostic character. In *Shorea* the shape of the filament is an important section character, and in many genera the shape of the connectival appendage is diagnostic. The presence or absence of a stylopodium, the shape of the ovary and stylopodium and the size of the style relative to that of the ovary are often diagnostic for sections and sometimes species, particularly in *Shorea* and *Hopea*.

*Fruit*. The accrescent fruit calyx can usually be divided into two parts, the basal tube or cup, which is adnate to the ovary in *Anisoptera* and some *Vatica*, and the distal lobes; in *Shorea* and *Parashorea*, *Dryobalanops*, *Neobalanocarpus* and *Hopea* the sepals themselves are divided into the distal wing-like lobes, and the usually somewhat broadened, thickened, saccate base adpressed to the nut. In *Cotylelobium* and some *Vatica* the calyx cannot be so divided and only one measurement is then given in the text. The number of long and short lobes is generically constant, though most genera have representatives in which they are all short and equal; the latter condition is considered to be an independent, secondary parallel reversion; see under evolutionary trends. The length of the longer lobes, and rarely the length and size of the shorter lobes, can be specifically diagnostic.

The degree to which the calyx is united at the base into a cup or tube is generically constant. *Vatica* excepted. In *Dipterocarpus* the tube may be spherical, or with five ribs, wings or tubercles arising at the line of fusion of the calyx segments.

The size of the nut is often diagnostic. Its apex in *Hopea* bears the discernible remains and shape of the stylopodium if present in the flower.

The structure of the seed has been described by CORNER (1976). In *Upuna* (and also *Stemonoporus*, *Vateriopsis* and *Pakaraimaea*) there is a highly vascularised placental region which is extended into a cup-shaped membrane in all but the last mentioned; this is the 'cupule chalazique' of HEIM (1892).

*Embryology and germination*. RAO (1953, 1956) described early ovular development in the Indian *Shorea robusta* GAERTN. f., *S. roxburghii* G. DON, *Vateria indica* L. and *Hopea wightiana* WALL. ex W. & A. One ovule only was found to develop. Embryo-sac development as of the *Polygonum* type. An initial oblique division of the zygote, followed by further oblique divisions of the daughter cells leads to a 4- or 8-celled pro-embryo, following which further division is normal. The endosperm is at first free nuclear. Fruit yielding more than one embryo were already known to BRANDIS; they are unusual, but occasionally occur in many species and genera, while individual trees are known by foresters to produce a high proportion. FOXWORTHY (1932) indicated that this is the general rule in *Shorea resinosa*. MAURY (1970a) found that each embryo developed from a separate ovule in two species of the African *Monotes* (though it was not known how many ovules had been fertilised) but in the gregarious riparian S.E. Asian *Hopea odorata* she was able (1970b) to confirm true polyembryony, with up to 12 embryos developing from a single ovule. She reported possible polyembryony also in the Malayan *Shorea parvifolia*; in several other Malesian species false polyembryony of the *Monotes* type was demonstrated (1968, 1970b) and in some true polyembryony suspected. KAUR *et al.* (1978) have now confirmed nucellar agamospermy in *Shorea ovalis* and *S. agami*, and strongly inferred it in *Hopea subalata* and *Shorea resinosa*.

PIERRE (1889-91), HEIM (1892), BRANDIS (1895), BURKILL (1917-25), SYMINGTON (1943) and



Fig. 12. Sapling of *Hopea dryobalanoides* MIQ. Note pendent leaves with drip-tips. Brunei (Photogr. ASHTON, 1958).



MAURY (1978) have described the diverse forms of mature embryo, the last three describing also germination and seedlings from studies of selected species. Consistent differences exist between some genera and sections, but many are obscured by bigger differences related to fruit size, which can vary between closely allied species. As MAURY (1978) showed, there can be much variation within species, and unusual forms are associated with distinctive habitats, as in the Dry Dipterocarp forest species *Shorea roxburghii* and *S. siamensis*, in which the germination is cryptocotylar. The cotyledons are large,  $\pm$  unequal (subequal in many species of *Shorea* sect. *Shorea*, *Richetioides*, *Pentacme* and some others, and in most *Vatica* and *Cotylelobium*); they are markedly unequal in *Dryobalanops*, *Neobalanocarpus*, and *Shorea* sect. *Anthoshorea*, and also in sect. *Doona* where one, large and ruminant, is retained within the pericarp at germination, while the other is small, laminar and photo-synthetic. Often the larger cotyledon is folded round the smaller, which  $\pm$  encloses the lignified placenta with the radicle lying outside. Both cotyledons are ruminant, much folded and remain within the pericarp in *Dipterocarpus* and *Stemonoporus*, the embryo being freed by elongation of the cotyledonary petioles; one is thus in *Shorea* sect. *Doona*; they are folded but become freed in *Anisoptera*, *Dryobalanops*, *Shorea* sect. *Anthoshorea* and some large-fruited *Vatica*. In some *Vatica*, and in *Cotylelobium* and *Stemonoporus* the cotyledons are lacinate. In *Shorea* sect. *Pachycarpae*, many species of sect. *Brachypterae* and some other large-fruited *Shorea* they are hastate, fleshy and prismatic, with the 2 inner faces flat and the outer convex; in many such species they remain within the pericarp until the embryo has rooted as in *Dipterocarpus*, with the embryo initially emerging by elongation of the cotyledonary petioles though unlike *Dipterocarpus* the cotyledons are ultimately freed. In typical medium or small-fruited dipterocarps (including some species of *Dipterocarpus*) germination is epigeal however, the cotyledons expand and become laminar, remaining yellowish or reddish (violet or magenta in *Shorea* sect. *Richetioides*) but photosynthesising to a limited extent.

The embryo usually remains small until immediately prior to germination, when the radicle rapidly elongates and bursts through the fruit apex, splitting the pericarp irregularly or (in most *Vatica* and in *Vateria*, *Stemonoporus*, many *Hopea* and *Dryobalanops*)  $\pm$  equally into 3 valves.

The first true leaves are opposite with interpetiolar stipules (except some *Vatica*), subsequent leaves spiral except in *Dryobalanops*, *Anisoptera*, *Vateria*, and occasionally others with 2 or more pairs of opposite seedling leaves. In *Anisoptera* the first 4 leaves sometimes appear in an estipulate whorl.

*Seedlings and saplings.* The first series of spirally arranged leaves in dipterocarp seedlings are characterised by their thinness, their long slender petioles, and their prominently acuminate apices (Fig. 5, 12); the tomentum, if present, is longer and sparser than in mature trees; stipules are narrower and more persistent. In *Dipterocarpus* the seedlings of all species are very similar in leaf shape and tomentum, though the stipule and resting bud tomentum already have the diagnostic characters that they possess in the mature tree. In most other genera the seedling is characteristic of the section and frequently the species. The seedling leaves give way rather abruptly to leaves resembling those of the mature tree but which are larger and more attenuate. This transitional stage is often absent in *Vatica* and *Hopea*, but persists until the crown emerges in canopy species.

*Taxonomic importance of the structure of embryo and seedling.* The potential taxonomic importance of the characters of the ripe embryo and the germinating seedling in the *Dipterocarpaceae* was indicated by HEIM (1892) and BURKILL (1920), and it has been in the Angiosperms as a whole by STEBBINS (1974), who claimed that "seedlings tend to be constant within genera and families, and to differ in a regular fashion between these categories, more than any other kind of characters."

In dipterocarps, these features in some cases confirm present concepts, and in others suggest some new relationships (MAURY et al., 1975; MAURY, 1978, 1979). The following characters have proved useful:

*Ripe embryo.* The position of the hypocotyl which, on meridian section, is implanted in the inferior half of the seed, in the superior half, in the middle, or in the apical quarter. When the free cotyledonary lobes are located towards the right side and the folding axis towards the left one, the hypocotyl is *dexter*; it can alternatively be *vertical* or *sinister*; the apical hypocotyl can be *horizontal-dexter* or *recurved-sinister*.

The cotyledonary folds, in equatorial section, are *covering* (folded as the pages in a book), or

*encircling* (rolled pages), or *juxtaposed* (a lateral half for each cotyledon). In meridian sections relative to the placental axis, the cotyledons are *piled-up* obliquely, or *parallel*, or *superposed*. The apex of the lamina can be folded towards the tip of the hypocotyl.

The lamina of the cotyledons are *entire*; or *lobate*, in which case there are two thick lateral lobes on both sides of the petiole, connected by a narrow, thin meridian zone (MAURY, 1978, vol. 2: p. 117) or *emarginate*, that is of intermediary shape. The lamina shape in each of these types can be *transverse* (type *Anthoshorea*: entire, type *Shorea*: bilobate), or *elongate* (type *Richetioides*: entire, type *Mutica*: bilobate), or *intermediate*. In each of these types, the lamina can be either thin or fleshy.

*Germinating seedlings*. The pericarp either splits under pressure or from the unfolding cotyledons and elongating hypocotyl, or dehisces independently prior to germination. The growth of the cotyledons terminates either before the pericarp splits, or later on during the development of the seedling. Cotyledonary nodes are characterized by the ratio of the number of gaps to the number of resin ducts per cotyledon. Stomata, when fully developed, provide further useful characters (MAURY, 1978, p. 154). In *Dipterocarpoideae* the cotyledons reach their final size in the ripe embryo. Germination leads only to unfolding of the cotyledons and the elongation of the hypocotyl. In this case, therefore, the ripe seed contains all the systematic and phylogenetic information that cotyledons can provide. The shape, structure, and organization of dipterocarpoid cotyledons are constant but only at generic and lower levels. Nevertheless, the interpretation of these characters is easier in seedlings when the cotyledons have fully unfolded, and when the phyllotaxy of the first node and the epidermal characters of the first true leaves provide additional information.

*Monotoideae* and *Pakaraimoideae* therefore share independent dehiscence of the pericarp, continued growth of the cotyledons following germination, apical folding of the cotyledons (not confirmed in *Pakaraimaea*) and albumen in the ripe embryo, in all these differing from *Dipterocarpoideae*. In the Asiatic subfamily, the group of genera *Hopea*, *Neobalanocarpus*, and *Shorea* (with imbricate ripe fruit calyx) appear to be differentiated from the group of the genera *Dipterocarpus*, *Anisoptera*, *Upuna*, *Cotylelobium*, *Vatica*, *Vateria*, and *Stemonoporus* (with valvate ripe fruit calyx). *Parashorea* in the former group, and *Dryobalanops*, which is in the latter on the basis of embryo characters, have subvalvate calyx in the ripe fruit.

Embryo and seedling characters provide novel insights in the presently recognized genera *Shorea* and *Parashorea* on the one hand, and *Vatica*, *Vateria*, and *Stemonoporus* on the other hand (MAURY, *l.c.*). On this basis, *Shorea* sect. *Doona*, *Pentacme*, *Anthoshorea*, *Shorea*, *Richetioides*, the combined sect. *Pachycarpae*, *Mutica*, *Rubella*, *Brachypterae*, and *Oralis* (that is, subg. *Rubroshorea* MEIJER), and the genus *Parashorea* appear to be at the same taxonomic level. Within this grouping, *Shorea* sect. *Doona*, *Pentacme* and *Anthoshorea* form a subunit. *Shorea* sect. *Shorea*, *Richetioides*, and *Rubroshorea* another, while *Parashorea* stands alone but close to 'Rubroshorea'. The *Rubroshorea* grouping is indeed much more heterogeneous than the others.

The relations between and within the genera *Upuna*, *Cotylelobium*, *Vatica*, *Vateria*, and *Stemonoporus* suggest that further discussion of *Vatica*, and also *Stemonoporus* might become justified. The affinities are stronger between *Upuna*, *Cotylelobium* and *Vatica* sect. *Sunapteae* and *Vatica* p.p. on the one hand, and between *Vatica* sect. *Vatica* p.p., *Stemonoporus* and *Vateria* on the other hand. The complexity of the latter three groups (MAURY, *l.c.*) requires additional study.

*Literature*: ANDERSON, Ph.D. Thesis, Edinburgh Univ. (1961); ANTHONY, Acad. Sc. 276 (1973) 193; Gard. Bull. Sing. 29 (1974) 17; Marcellia 38 (1974) 99; ASHTON, Gard. Bull. Sing. 20 (1963) 229–284; Man. Dipt. Brun. (1964), Suppl. (1968); Gard. Bull. Sing. 22 (1967) 259–352; Blumea 20 (1972) 357–366; Rev. Flora of Ceylon 1 (2) (1977) 166–196; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 1–144; Burkill, J. Str. Br. R. As. Soc. 75 (1917) 43–48; *ibid.* 76 (1917) 161–167; *ibid.* 79 (1919) 39–44; *ibid.* 81 (1920) 3–4, 49–78; *ibid.* 86 (1922) 271–291; *ibid.* 87 (1923) 218–222; Gard. Bull. Str. Settl. 3, 1 (1925) 4–9; CORNER, Wayside Trees of Malaya (1940) 30; Ann. Bot. 27 (1963) 339; The seeds of Dicotyledons 1 (1976) 33, 35, 119, & Atlas; FOXWORTHY, Mal. For. Rec. 10 (1932); GILG in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 237–269; GUÉRIN, Bull. Soc. Bot. Fr., Mém. 11 (1907) 93; HALLÉ, OLDEMAN & TOMLINSON, Trop. Trees & Forests. An architectural analysis (1978); HEIM, Bull. Soc. Bot. Fr. 39 (1892) 149–154; Rech. Dipt. (1892) 1–186; HONG, Mal. For. 42 (1979) 280; KAUR *et al.* Nature 271, 5644 (1978) 440; MAGUIRE *et al.* Taxon 26 (1977) 341–385; MAURY, Bull. Soc. Hist. Nat. Toulouse 104 (1968) 187–202; *ibid.* 106 (1970a) 277–281; *ibid.* 106 (1970b) 282–288; Thesis:



Dipterocarpaceés, du fruit à la plantule. Toulouse (1978) 2 vol.; MAURY-LECHON, Mém. Mus. Nat. Hist. Nat. Paris, n.s. sér. B, 26 (1979) 81–106; MAURY *et al.* Rev. Palaeobot. Palynol. 19 (1975) 241–289; METCALFE & CHALK, Anat. Dicot. 1 (1950); MEIJER, Acta Bot. Neerl. 12 (1963) 310–353; MEIJER & WOOD, Sabah For. Rec. n. 5 (1964) 1–344; NG, Mal. For. 38 (1975) 153; *ibid.* 39 (1976) 91; PIERRE, Fl. For. Coch. 3–4 (1889–91); RAO, Phytomorph. 3 (1953) 476–484; Proc. Nat. Inst. Sc. India 21 (1955) 247–255; Curr. Sci. 25 (1956) 128–129; J. Mysore Univ. 15, 3 (1956) 7–15; SINGH, Mal. For. 29 (1966) 13; VAN SLOOTEN, Bull. Jard. Bot. Btzg III, 17 (1941) 132; SYMINGTON, Mal. For. Rec. 16 (1943); THORENAAR, Meded. Proefst. Boschw. 16 (1926); WHITMORE, New Phytol. 61 (1962) 191–220; Gard. Bull. Sing. 19 (1962) 321–371; C. WOON & H. KENG, Gard. Bull. Sing. 32 (dated 1979) 1–42, with numerous figures on 31 pl.

Anatomy. *Stem*. The whole family shares the combined characters of vested pits and the presence of tyloses. The *Dipterocarpoideae* are distinguished by two unique characteristics: The lateral (and apical also in *Stemonoporus*) leaf traces separate from the central vascular cylinder well below the node, passing up through the bark before entering the petiole; in *Dryobalanops* they arise at or even before the previous node. BURCK, PIERRE and HEIM used such characters extensively for taxonomic purposes, but BRANDIS was rightly cautious of such boldness before much more intensive examinations have been undertaken; it is likely that such characters could prove useful, especially at the species level. Vertical intercellular resin canals, scattered or in arcs, are universal also in the subfamily, and occur characteristically in the pith of internodes and leaf traces; in *Dryobalanops* there is a single central branching duct, in others varying numbers of peripheral ducts of varying or constant diameter. These would also merit intensive investigations.

The *wood anatomy* has been treated exhaustively by GOTTWALD & PARAMESWARAN who confirmed and extended the work of DESCH, demonstrating that the great diversity of wood anatomy provides valuable taxonomic characters at subfamilial, tribal, generic, infrageneric and sometimes species level. The accompanying Table 1 is modified from their work and summarises the

Table 1. Principal groupings of Malesian dipterocarps based on wood anatomy

	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Vatica</i> most spp.		+						+				+	+
<i>Vatica</i> § <i>Vatica</i> p.p.	+							+				+	+
<i>Cotylelobium</i>	+				+			+				+	+
<i>Upuna</i>	+						+	+				+	+
<i>Anisoptera</i>	+				+		+	+					+
<i>Dipterocarpus</i>	+				+			+					+
<i>Dryobalanops</i>	+				+				+				+
<i>Hopea</i>		+							+				
<i>Hopea ferrea</i>		+			+				+				
<i>Neobalanocarpus heimii</i>		+			+				+				
<i>Shorea</i> § <i>Pentacme</i>		+							+				
§ <i>Shorea</i>		+							+			+	
§ <i>Anthoshorea</i>		+			+				+				
<i>Shorea montigena</i>		+							+		+		
§ <i>Brachypterae</i> , <i>Rubella</i> , <i>Pachycarpae</i> , <i>Mutica</i>		+							+				
<i>Shorea leprosula</i> , <i>S. ovata</i> , <i>S. teysmanniana</i>		+							+	+			
§ <i>Richetioides</i>		+							+	+			
<i>Parashorea</i>		+							+				
<i>Parashorea smythiesii</i>		+							+	+			

Key to wood characters:

1. Vessels solitary

2. Vessels grouped

3. Uniseriate rays

4. Rays storied

5. SiO<sub>2</sub> abundant, universal
6. SiO<sub>2</sub> frequent

7. SiO<sub>2</sub> absent

8. Resin canals scattered

9. Resin canals in tangential bands
10. Resin canals in medullary rays

11. Fibres thin-walled (<3 µm)

12. Fibres thick-walled (>3 µm)

13. Fibres with bordered pits

principal grouping they distinguished in Malesian taxa. The diameter of vessels, the size of rays, and the wood parenchyma distribution are also of more restricted diagnostic value.

*Petiole.* PIERRE, HEIM, MAURY, and other authors have used the petiolar anatomy, and particularly the arrangement of the vascular bundles as seen in transverse section at the distal end (the 'caractéristique'), as a guide to classification and species determination. HEIM in particular placed great weight on small differences observed in single specimens, as in his treatment of *Cotylelobium*. I have found that, though some genera possess a characteristic basic arrangement, variation within single species greatly exceeds variation between species except in some *Dipterocarpus*, and sections *Shorea* and *Hopea* of those genera, where the anatomy is very complex owing to the presence of several concentric arcs of vascular bundles. MAURY (1978) has shown that the sequential changes in petiolar anatomy in the first leaves of seedlings is distinctive at sectional and generic level.

*Literature:* DEN BERGER & ENDERT, Meded. Proefst. Boschw. 11 (1925) 98; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 1–144; BURCK, Ann. Jard. Bot. Btztg 6 (1887) 145–193; DESCH, Mal. For. Rec. 14 (1941); GOTTWALD & PARAMESWARAN, Bot. Jahrb. 85 (1966) 410–508; HEIM, Rech. Dipt. (1891); MAURY, Thesis: Diptérocarpacees, du fruit à la plantule, Toulouse (1978); METCALFE & CHALK, Anat. Dicot. 1 (1957) 212–220; MOLL & JANSONIUS, Mikrographie des Holzes der auf Java vorkommenden Baumarten 1 (1906) 343; MULLER, Bot. Jahrb. 3 (1882) 446; PIERRE, Fl. For. Coch. (1889–91) t. 212–259; SOLEREDER, Syst. Wert der Holzstruktur (1885) 81.

*Palynology.* The pollen grains in *Dipterocarpaceae* are mostly spherical and range in size from 17  $\mu\text{m}$  (*Vatica havilandii*) to 87  $\mu\text{m}$  (*Dipterocarpus humeratus*). *Pakaraimoideae* and *Monotoideae* are characterized by tricolporate pollen grains with a well developed endexine and a distinct foot layer. *Dipterocarpoideae* have tricolpate pollen grains which lack an endexine and possess a thin, often laminated basal layer which is probably homologous with a foot layer. Exine structure in *Pakaraimoideae* is reticulate-columellate with straight columellae, in *Monotoideae* reticulate-columellate with columellae inclined towards the centre of the lumina in a tilioid pattern. In *Dipterocarpoideae* exine structure varies between a) finely reticulate-columellate (*Hopea*, *Shorea*), b) a structure in which columellae and tectum are intimately fused, forming urn-shaped structures (*Dryobalanops*, *Dipterocarpus*) and c) a tilioid structure (*Vatica*). The surface of the muri may be crenelated (*Hopea*, *Shorea*, *Stemonoporus*), crotonoid (*Dryobalanops*, *Dipterocarpus*) or smooth (*Dipterocarpus*, *Vatica*). *Stemonoporus* is characterised by a fairly thick basal layer and operculate colpi. Within *Dipterocarpoideae* a relation between flower size and pollen size has been established. The large flowered genus *Dipterocarpus* has significantly larger pollen grains than genera with smaller flowers such as *Hopea*, *Shorea* and *Vatica*, while *Dryobalanops* is intermediate. Within the genus *Dipterocarpus* a similar correlation exists between size of flowers and of pollen. The pollen of *Pakaraimaea* is of a generalised type, common in many Angiosperm families, but the pollen types of *Monotoideae* and *Dipterocarpoideae* are more specialized. In *Monotes*, the thick wall with well developed endexine and endoapertures may be related to the seasonal climate of dry evergreen forest to which the genus is adapted. In most *Dipterocarpoideae* the endexine and consequently also the endoaperture appears to have been lost, resulting in the development of a thin, very flexible wall, with slit-like colporate apertures only.

The presence of a tilioid exine structure in *Monotoideae* and *Dipterocarpoideae* indicates affinities with *Tiliaceae* (*Brownlowioideae*). The suggestion by KOSTERMANS that *Pakaraimaea* is close to *Schoutenia* (*Tiliaceae*) is not supported by pollen morphology, since the latter genus has quite different triporate-echinate pollen. The pollen morphology in *Sarcolaenaceae* (*Chlaenaceae*) is also quite different from *Dipterocarpaceae*.

*Literature:* CARLQUIST, Brittonia 16 (1964) 231–254; KOSTERMANS, Taxon 27 (1978) 357–359; MAGUIRE *et al.* Taxon 26 (1977) 341–385; MAURY *et al.* Review Palaeob. Palynol. 19 (1975) 241–289. — J. MULLER.

*Cytotaxonomy.* Despite the ecological and economic importance of the *Dipterocarpoideae*, we have at present still rather a limited knowledge of their cytology.

JONG & LETHBRIDGE (1967) and JONG (1976), using the squash technique, established the occurrence of two main basic chromosome numbers,  $x = 7$  and  $x = 11$  among Indo-Malesian species in nine genera studied. This is in accord with earlier chromosome counts by ROY & JHA (1965) on



five Indian taxa representing four genera. Each basic number characterises a group of more or less related genera:  $x = 11$  the genera *Anisoptera*, *Dipterocarpus*, *Upuna*, *Vatica*, *Vateria* and *Stemonoporus*, and  $x = 7$  *Dryobalanops*, *Hopea*, *Neobalanocarpus*, *Parashorea*, and *Shorea*.

These observations are, however, at variance with those of TIXIER (1953, 1960) and PANCHO (1971). TIXIER published chromosome counts for some 13 Indo-Chinese taxa:  $2n = 12$  for *Pentacme* (reduced here to *Shorea sect. Pentacme*) and *Shorea*, and  $2n = 20$  for *Anisoptera*, *Dipterocarpus*, *Hopea* and *Shorea* (see Table 2). PANCHO (*l.c.*) reported also  $2n = 20$  in two Philippine species of *Dipterocarpus*. ROY AND JHA (1965) on the other hand, observed  $2n = 22$  in *Dipterocarpus alatus*, a species also studied by TIXIER (1953). That dysploidy or aneuploidy may exist within a genus or species remains however to be firmly established, partly because differences in chromosome counts appear to vary with observers rather than with taxa. No new basic numbers have yet been detected in recent cytological studies on some dipterocarps from the Malay Peninsula, Borneo and Ceylon (JONG & TAYLOR, unpubl.; SINGH, 1977).

The diploid numbers of one species of *Stemonoporus*, and two of *Vateria*, all  $2n = 22$ , and three species of *Shorea* in the sections *Doona* and *Pentacme*, all  $2n = 14$ , conform to taxonomic expectation (JONG, 1976; JONG & KAUR, 1979), thus confirming on the one hand the position of *Stemonoporus* and *Vateria* in the  $x = 11$  group of genera, and on the other ASHTON's (1972) reduction of *Doona* and *Pentacme* to *Shorea*.

Similarity in chromosome number, it should be emphasized, does not necessarily imply resemblances in other features of the genome nor an unequivocal indication of close taxonomic affinity. Dipterocarp chromosomes like those of most other tropical hardwood species are small in size and rather uniform in morphology, and hence karyotypic variations are not readily discernible. Although certain differences for example in the number of satellited chromosomes and chromosome size have been noted by ROY & JHA (1965) among the five species they studied, the taxonomic value of such variation in the family however, has yet to be properly assessed from a wider and more representative sample (JONG & KAUR, 1979). *Neobalanocarpus heimii* (KING) ASHTON illustrates another important point: this taxonomically problematic species is diploid ( $2n = 14$ ) and has a highly irregular pattern of meiosis, at least in the single individual studied (JONG & LETHBRIDGE, 1967). Irrespective of the significance that might be attached to it (most probably a reflection of hybridity), such a meiotic pattern could not have been anticipated from an examination of somatic chromosomes. Thus meiotic information should be sought wherever possible in future cytological surveys, especially in taxonomically interesting taxa.

*Polyploidy*. Bearing in mind the difficulties involved in cytological sampling of tropical rain-forest trees, and the fact that much of the cytological information are based on cultivated specimens (often on only a single representative of a species), the available data indicate that polyploids are rare in the *Dipterocarpoideae*, although polyploid series are now known to occur in *Hopea* and *Shorea* ( $2n = 14, 21, 28$ ). *Hopea odorata* ( $2n = 14, 20$ ) and *Dipterocarpus tuberculatus* ( $2n = 20, 30$ ) are possibly examples of intraspecific polyploidy (see Table 2; also JONG, 1976; JONG & KAUR, 1979). *Hopea nutans* and *Shorea ovalis ssp. sericea* are both tetraploid, and cytologically the latter behaves as an autotetraploid (JONG & KAUR, 1979). A more extensive sampling might well disclose the existence of related diploid cytotypes in these two species. *Shorea ovalis* is morphologically variable, and it would be interesting to ascertain whether some of the distinct forms of this species are associated with any cytological variation.

Of special interest are triploid or near-triploid taxa of *Hopea* and *Shorea* (JONG, 1976; KAUR *et al.*, 1978), namely, *Hopea latifolia* (as *H. beccariana* in JONG, 1976), *H. subalata*, and *Shorea resinosa*, all  $2n = 3x = 21$ . *Hopea odorata* has  $2n = 20-22$ .

In view of undecisive counts of  $2n = 20, 21$  and  $22$  encountered in root tips of *Hopea beccariana*, *H. subalata* and *H. odorata*, SOMEKO (1978) proposed that *Hopea* may be dibasic, with  $x = 7$  and  $x = 10$  or  $11$ , thus denying the possible occurrence of triploidy or near triploidy. ROY & JHA (1965) earlier published a diploid number  $2n = 14$  for Indian plants of *H. odorata* making the interpretation of  $2n = 20-22$  for the same species (growing in Kepong Arboretum) as a near-triploid more plausible.

The above species are able to produce viable seeds and, except for the first mentioned, also form a varying proportion of seeds containing multiple embryos.

That chromosome sterility resulting from triploidy or near triploidy can be circumvented by agamospermy has been inferred by KAUR *et al.* (1978) and JONG & KAUR (1979). Variations in the somatic number could of course be due to the presence of accessory chromosomes although such chromosomes have not previously been clearly identified in the *Dipterocarpaceae*.

The concurrence of triploidy and reproduction by seed points to the possible existence of agamospermy in these plants. Indirect as well as some embryological evidence (in the case of *Hopea subalata*) support such a deduction (KAUR *et al.*, 1978); conclusive evidence of nucellar polyembryony has come from tetraploid *Shorea oralis ssp. sericea* (SINGH, 1977; KAUR *et al.*, 1978). Thus there appears to be a close association between polyploidy, multiple seedlings, and agamospermy and possibly with hybridity in the above mentioned cases; such a relationship is, however, by no means a universal one for there are diploids such as *Shorea agamii* ( $2n = 14$ ) in which agamospermy is also suspected to be in operation (KAUR *et al.*, 1978; JONG & KAUR, 1979). This species also produces multiple seedlings in varying proportions.

Three of the taxa studied by TIXIER (1953, 1960) might possibly be triploid, but their chromosome numbers need confirmation: one form of *Dipterocarpus tuberculatus*,  $2n = 30$ ; *Hopea odorata* and *Shorea obtusa*, both reported to have  $2n = 20$ .

All the chromosome numbers published to date pertain to genera in the subfamily *Dipterocarpoideae* and are listed in Table 2. Cytological information is not yet available for any member of *Cotylelobium*, nor of the subfamilies *Monotoideae* and *Pakaraimoideae*.

*Hybridisation.* The triploid condition might have arisen in a variety of ways in the different taxa. In the case of *Hopea subalata*, known only from Kanching Forest Reserve in Peninsular Malaysia where a few small groups have been found (SYMINGTON, 1943) triploidy probably occurred as an isolated event. By contrast, in *H. odorata*, a riverbank tree of widespread distribution occurring in the evergreen forests of Indo-China, Burma, Thailand and northern Peninsular Malaysia (SYMINGTON, 1943; ASHTON, pers. comm.), diploid and near triploid cytotypes are known, and triploidy could have originated more than once in the different parts of its range, or alternatively it could have spread with the help of agamospermy from a single origin. A more careful study of these and other polyploids and their nearest relatives is required before greater understanding can be attained. Similarly, it is uncertain whether the triploids are derived from occasional union of haploid and unreduced gametes in a diploid cytotype, or from the habitual union of such gametes as known only in *Leucopogon juniperinum* (see SMITH-WHITE, 1955), or from hybridisation between diploid and tetraploid congeners. It is a well known fact that most triploids have low fertility (although they are rarely completely sterile, LEWIS, 1967), and are thus vulnerable to extinction unless they possess some means of ensuring their perpetuation at least in the short term. It has been inferred that agamospermy is the most likely mechanism (KAUR *et al.*, 1978), and that a combination of genes favouring apomixis could have been brought together through hybridisation. The origin of the tetraploid status of *Shorea oralis ssp. sericea* is still uncertain, but the occurrence of chromosomal heterozygosity and agamospermy (JONG & KAUR, 1979) does strongly point to the involvement of hybridisation in its origin.

The possible hybrid nature of *Neobalanocarpus heimii* has already been mentioned (see also JONG & LETHBRIDGE, 1967; JONG, 1976) and further supportive evidence from meiotic examination of additional individuals as well as from embryological and other studies of its reproductive biology are required for a fuller understanding.

The best known dipterocarp interspecific hybrid in the aseasonal tropics is *Shorea leprosula*  $\times$  *S. curtisii*, both diploids of close affinity. The hybrid has been reported from several localities in Peninsular Malaysia and from Singapore. Intermediate forms between *Vatica rassak* and *V. umbonata* are found in unstable habitats where the ranges of the two species overlap in East Sabah. Also some collections of *Anisoptera costata* and *A. curtisii* suggest local hybridisation in N.W. Malaya. See further the notes under the species descriptions. Morphological hybrids are otherwise rare in the Lowland Mixed Dipterocarp forests (ASHTON, 1969) although they appear to be more common in the more seasonal regions, especially at zones of contact between allopatric taxa (examples given in text). There is at present, however, no cytogenetic information on any of the putative hybrids.

*Literature:* ASHTON, Bot. J. Linn. Soc. 1 (1969) 149–153; Blumea 20 (1972) 357–366; JONG in Burley & Styles (eds.), Tropical Trees: variation, breeding and conservation; Acad. Press (1976)



Table 2. Published chromosome numbers of the Dipterocarpaceae

Name	n	2n	Author
<b>Anisoptera KORTH.</b>			
<i>costata</i> KORTH.			
(as <i>A. cochinchinensis</i> PIERRE ex LANESS.)		20	TIXIER, 1953
? <i>laevis</i> RIDL.		22	JONG & LETHBRIDGE, 1967
<i>laevis</i> RIDL.		22	SOMEGO, 1978
<i>scaphula</i> (ROXB.) KURZ		22	SOMEGO, 1978
(as <i>A. glabra</i> KURZ)		20	TIXIER, 1960
<b>Dipterocarpus GAERTN. f.</b>			
<i>alatus</i> ROXB.		20	TIXIER, 1953
<i>alatus</i> ROXB.	11	22	ROY & JHA, 1965
<i>baudii</i> KORTH.		22	JONG & LETHBRIDGE, 1967
<i>cornutus</i> DYER		22	SOMEGO, 1978
<i>costatus</i> GAERTN. f.			
(as <i>D. artocarpifolius</i> PIERRE ex LANESS.)		20	TIXIER, 1960
<i>elongatus</i> KORTH.			
(as <i>D. warburgii</i> BRANDIS)		20	PANCHO, 1971
<i>intricatus</i> DYER		20	TIXIER, 1953
<i>kunstleri</i> KING			
(as <i>D. speciosus</i> BRANDIS)		20	PANCHO, 1971
<i>oblongifolius</i> BL.		22	SOMEGO, 1978
<i>obtusifolius</i> TEYSM. ex. MIQ.		20	TIXIER, 1953
<i>sarawakensis</i> SLOOT.	c. 22	JONG & LETHBRIDGE, 1967	
<i>tuberculatus</i> ROXB.		20	TIXIER, 1960
<i>tuberculatus</i> ROXB. var.		30	TIXIER, 1960
<i>turbinatus</i> GAERTN. f.		20	TIXIER, 1960
<b>Dryobalanops GAERTN. f.</b>			
<i>aromatica</i> GAERTN. f.		14	JONG & LETHBRIDGE, 1967
			SOMEGO, 1978
<i>oblongifolia</i> DYER		14	JONG & LETHBRIDGE, 1967
			SOMEGO, 1978
<b>Hopea ROXB.</b>			
<i>beccariana</i> BURCK		20, 21, 22	SOMEGO, 1978
<i>glabra</i> W. & A.			
(as <i>H. wightiana</i> WALL. ex. W. & A.)		14	JONG & LETHBRIDGE, 1967
<i>latifolia</i> SYM.			
(as <i>H. beccariana</i> BURCK)		21	JONG, 1976
<i>nervosa</i> KING		14	SOMEGO, 1978
<i>nutans</i> RIDL.	14	JONG & LETHBRIDGE, 1967	
<i>nutans</i> RIDL.		28	SOMEGO, 1978
<i>odorata</i> ROXB.		20	TIXIER, 1953
<i>odorata</i> ROXB.	7	14	ROY & JHA, 1965
<i>odorata</i> ROXB.		20, 21, 22	KAUR <i>et al.</i> , 1978
			SOMEGO, 1978
<i>pubescens</i> RIDL.	c. 7	JONG & LETHBRIDGE, 1967	
<i>sangal</i> KORTH.		14	SOMEGO, 1978
<i>subalata</i> SYM.		21	KAUR <i>et al.</i> , 1978
<i>subalata</i> SYM.		20, 21, 22	SOMEGO, 1978
<b>Neobalanocarpus ASHTON</b>			
<i>heimii</i> (KING) ASHTON	7	14	JONG & LETHBRIDGE, 1967
			SOMEGO, 1978
<b>Parashorea KURZ</b>			
<i>densiflora</i> SYM.		14	SOMEGO, 1978
<b>Shorea ROXB. ex. GAERTN. f.</b>			
<i>acuminata</i> DYER		14	KAUR <i>et al.</i> , 1978
			SOMEGO, 1978

Table 2. (Continued)

Name	n	2n	Author
(Shorea)			
<i>agamii</i> ASHTON		14	KAUR <i>et al.</i> , 1978
<i>argentifolia</i> SYM.		14	KAUR <i>et al.</i> , 1978 SOMEGO, 1978
<i>assamica</i> DYER			
<i>ssp. globifera</i> (RIDL.) SYM.		14	SOMEGO, 1978
<i>bracteolata</i> DYER		14	SOMEGO, 1978
<i>contorta</i> VIDAL		14	JONG & KAUR, 1979
<i>curtisii</i> DYER <i>ex</i> KING		14	JONG & LETHBRIDGE, 1967 SOMEGO, 1978
<i>gardneri</i> (THW.) ASHTON		14	JONG & KAUR, 1979
<i>glauc</i> KING		14	SOMEGO, 1978
<i>guiso</i> (BLCO) BL.		14	SOMEGO, 1978
<i>hypochroa</i> HANCE		14	SOMEGO, 1978
<i>leprosula</i> MIQ.		14	JONG & LETHBRIDGE, 1967 SOMEGO, 1978
<i>macrophylla</i> (DE VR.) ASHTON		14	KAUR <i>et al.</i> , 1978
<i>macroptera</i> DYER			
<i>ssp. macroptera</i>		14	KAUR <i>et al.</i> , 1978 SOMEGO, 1978
<i>maxwelliana</i> KING		14	SOMEGO, 1978
<i>mecistopteryx</i> RIDL.		14	SOMEGO, 1978
<i>multiflora</i> (BURCK) SYM.		14	SOMEGO, 1978
<i>obtus</i> WALL.		20	TIXIER, 1953
<i>ovalis</i> (KORTH.) BL.		28	SOMEGO, 1978
<i>ssp. sericea</i> (DYER) ASHTON	14	28	JONG & LETHBRIDGE, 1967
<i>palembanica</i> MIQ.		14	SOMEGO, 1978
<i>parvifolia</i> DYER		14	KAUR <i>et al.</i> , 1978 SOMEGO, 1978
<i>pauciflora</i> KING		14	JONG & LETHBRIDGE, 1967 SOMEGO, 1978
<i>pinanga</i> SCHEFF.			
(as <i>S. compressa</i> BURCK)		12	TIXIER, 1960
<i>pinanga</i> SCHEFF.		12	TIXIER, 1960
<i>pinanga</i> SCHEFF.		14	JONG & KAUR, 1979
<i>platyclados</i> SLOOT. <i>ex</i> FOXW.		14	SOMEGO, 1978
<i>resinosa</i> FOXW.		21	KAUR <i>et al.</i> , 1978
<i>robusta</i> GAERTN. <i>f.</i>		14	RAO, 1954
<i>robusta</i> GAERTN. <i>f.</i>	7	14	ROY & JHA, 1956, 1965
<i>robusta</i> GAERTN. <i>f.</i>		14	NANDA, 1962
<i>roxburghii</i> G. DON			
(as <i>S. talura</i> ROXB.)	7	14	ROY & JHA, 1965 SOMEGO, 1978
<i>siamensis</i> MIQ.			
(as <i>Pentacme siamensis</i> (MIQ.) DC.		12	TIXIER, 1953
<i>singawang</i> (MIQ.) MIQ.	7		JONG & LETHBRIDGE, 1967
<i>smithiana</i> SYM.	7		JONG & LETHBRIDGE, 1967
<i>splendida</i> (DE VR.) ASHTON		14	JONG & KAUR, 1979
(as <i>S. martiniana</i> SCHEFF.)		14	SOMEGO, 1978
<i>stenoptera</i> BURCK		14	KAUR <i>et al.</i> , 1978
<i>sumatrana</i> (SLOOT. <i>ex</i> THOR.) SYM.	7		JONG & LETHBRIDGE, 1967
<i>trapezifolia</i> (THW.) ASHTON		14	JONG & KAUR, 1979
<b>Upuna</b> SYM.			
<i>borneensis</i> SYM.		22	SOMEGO, 1978
<b>Vatica</b> L.			
<i>cinerea</i> DYER		22	SOMEGO, 1978
<i>odorata</i> (GRIFF.) SYM. <i>ssp. odorata</i>			
(as <i>V. grandiflora</i> DYER)	11	22	ROY & JHA, 1965 SOMEGO, 1978



Table 2. (Continued)

	Name	n	2n	Author
( <i>Vatica</i> )				
	<i>pauciflora</i> MIQ.			
	(as <i>V. wallichii</i> DYER)	11		JONG & LETHBRIDGE, 1967
	<i>rassak</i> KORTH.			
	(as <i>V. papuana</i> DYER)		22	JONG & LETHBRIDGE, 1967
	<i>staphiana</i> (KING) SLOOT.		22	JONG & LETHBRIDGE, 1967

79-84; JONG & KAUR, Mém. Nat. Hist. Mus. Paris B 26 (1979) 41-49; JONG & LETHBRIDGE, Notes R. Bot. Gard. Edinb. 27 (1967) 175-184; KAUR, HA, JONG, SANDS, CHAN, SOEPADMO & ASHTON, Nature 271, n. 5644 (1978) 440-442; LEWIS, Taxon 16 (1967) 267-271; NANDA, J. Ind. Bot. Soc. 41 (1962) 271-277; PANCHO, Taxon 20 (1971) 794-795; RAO, Ind. For. 80 (1954) 551-552; ROY & JHA, Sci. & Cult. 22 (1956) 236-238; J. Ind. Bot. Soc. 44 (1965) 387-397; SINGH (née AWATAR KAUR), Unpublished Ph.D. Thesis, University of Aberdeen (1977); SMITH-WHITE, Heredity 9 (1955) 79-91; SOMEGO, Mal. For. 41 (1978) 358; STEBBINS, Chromosomal Evolution in Higher Plants: Edward Arnold, London (1971); SYMINGTON, Mal. For. Rec. 16 (1943); TIXIER, Rev. Cytol. et Biol. Veg. 14 (1953) 1-2; *ibid.* 22 (1960) 65-70. — K. JONG.

Phytochemistry. General chemical properties were summarised by HEGNAUER (1966). Production of oleoresins (balms, resins) is characteristic of most members of the family. Their volatile portion consists mainly of sesquiterpenes such as humulenes, caryophyllenes, copaënes, elemenes and guaijenes (*e.g.* gurjunenes, apitonene); in some instances monoterpenoids predominate (*i.e.* borneol in the so-called 'Borneo camphor' from *Dryobalanops aromatica*). The sesquiterpene alcohol spathulenol occurs in balms of species of three of the four subgenera of *Shorea* (BISSET *et al.*, 1971). The resin fractions of the oleoresins are composed of triterpenoids and usually consist of neutral and acidic constituents. Dipterocarpol (= hydroxydammaradienone-II) is a ketonic tetracyclic triterpene alcohol having the so-called dammarane skeleton; together with similar compounds like dryobalanone it represents an outstanding feature of the subfamily *Dipterocarpoideae*. The dammarane skeleton is also present in a number of acidic resin constituents such as dipterocarpolic acid, dammarenic acid (I) and shoreic acid (II). Other dipterocarpaceous resin triterpenoids possess the pentacyclic skeletons of ursolic acid (*e.g.* ursonic acid, asiatic acid, the lactonic compound B [III] *etc.*), oleanolic acid (*e.g.* oleanolic acid, hederagenin *etc.*) and betulinic acid (*e.g.* erythrodiol). Compounds I, II and III have an oxidatively cleaved A-ring: they represent so-called A-ring seco-triterpenes, which seem to be rather characteristic of dipterocarps. Many of the oleoresin constituents mentioned were described since 1966 (*e.g.* CHAN, 1969; CHEUNG, 1967, 1968; CHEUNG & FENG, 1968; CHEUNG & YAN, 1972; CHEUNG & WONG, 1972; GUPTA & SUKH DEV, 1971; HARRISON *et al.*, 1971; LANTZ & WOLFF, 1968). Some attention has been paid also to the phenolic constituents of leaves, barks, woods and seeds. Dipterocarps tend to produce proanthocyanidins (*i.e.* oligomeric catechins formerly called leucoanthocyanidins) and gallic acid derivatives. These polyphenolic compounds are building stones of condensed and hydrolysable tannins; both types of tannins are present in taxon-characteristic ratios and amounts in many members of the family. Two derivatives of gallic acid deserve mentioning. Ellagic acid, the dilactone formed on hydrolysis of ellagitannins, was shown to occur in leaves and seeds of many species and bergenin, a striking derivative of gallic acid, has been isolated up to this day from members of *Dipterocarpus*, *Shorea*, *Stemonoporus* and *Vateria* (BHRARA & SESHADRI, 1966; DESAI *et al.*, 1967, 1971; BANDARANAYAKE *et al.*, 1977). Most probably both compounds will turn out in future to represent good chemical characters of *Dipterocarpaceae*. The same may be true for *Hopea*-phenol, a phenolic constituent of barks and heartwoods, which is presently known from species of *Balanocarpus*, *Hopea* and *Shorea* (COGGON *et al.*, 1965, 1966; MADHAV *et al.*, 1967). *Hopea*-phenol was shown to be a condensation product of four molecules of the trihydroxystilbene resveratrol. It is chemically similar to the viniferin-type phytoalexins of *Vitis vinifera*. With regard to phenolic leaf constituents BATE-SMITH and WHITMORE (*ex* HEGNAUER, 1966) stressed the frequent occurrence of vicinal trihydroxylation (ellagic acid, gallic acid; B-ring in the flavonoids myricetin and prodelfinidin) in dipterocarps. As far as investigated, seed fats (oils) of *Dipterocarpaceae* are characterized by a

strong predominance of stearic and oleic acid. Sal fat (oil of seed kernels of *Shorea robusta*) was shown recently to contain also small amounts (c. 4%) of 9,10-epoxystearic acid (BRINGI, 1972).

BATE-SMITH & WHITMORE (1959) examined the phenols of fresh leaves in 28 species in 8 genera, giving attention to those compounds known to be of chemotaxonomic interest elsewhere. A grouping of genera was arrived at on the basis of the leucoanthocyanins present and their abundance which little reflected grouping established by traditional means; no clear grouping of *Shorea* species by their established sections was possible, though *Neobalanocarpus* was confirmed to closely resemble *Hopea*.

Recently taxonomic potentialities of chemical characters at an intrafamilial level were discussed by several authors. DIAZ *et al.* (1966) and BISSET *et al.* (1966, 1967, 1971) showed that the composition of the oleoresins (sesquiterpene-fractions, triterpene-fractions) is rather characteristic of the taxa *Shorea* sect. *Doona*, *Anisoptera*, *Cotylelobium* and *Upuna* and that in the genera *Dryobalanops*, *Dipterocarpus* and *Shorea* the chemistry of oleoresins might be helpful to classification beneath generic level. Subsequently BANDARANAYAKE *et al.* (1975, 1977) stressed the systematic importance of resin composition in dipterocarps. According to these authors the significant differences in resin composition between representatives of *Shorea* sect. *Doona* and other sections do not agree with the proposition to merge *Doona* with *Shorea*. Very little work was performed with representatives of the African subfamily *Monotoideae* (*Monotes*, *Marquesia*) which lack resin ducts and seem to deviate chemically in several respects (DIAZ *et al.*, 1966) from the Asiatic subfamily *Dipterocarpoideae*. At present a chemotaxonomic discussion of relationships between these subfamilies seems to be premature. The same is true with regard to the recently described New World dipterocarpaceous genus *Pakaraimaea* (MAGUIRE & ASHTON, 1977) which according to KOSTERMANS (1978) would belong to *Tiliaceae*. The chemical evidence (GIANNASI & NIKLAS, 1977) given for dipterocarpaceous affinity is inadequate. Confirmation of the preliminary results reported by the authors mentioned as well as extension of phytochemical research are needed before chemical characters can make a serious contribution to the classification of the taxa concerned. Regarding relationships of *Dipterocarpoideae* with other plant families, the opinion held in 1966 by the present author is still valid; we are not yet in a position to discuss relationships in terms of chemical characters. On morphological arguments relationships with members of *Malvales* are often postulated. Presently known chemical characters do not convincingly contradict such a classification, but they form by no means strong evidence for such an affinity.

*Literature:* BANDARANAYAKE *et al.*, *Phytochemistry* 14 (1975) 2043; *ibid.* 16 (1977) 699; BATE-SMITH & WHITMORE, *Nature* 184 (1959) 795–796; BHRARA & SESHADRI, *Curr. Sci.* 35 (1966) 486; BISSET *et al.*, *Phytochemistry* 5 (1966) 865; *ibid.* 6 (1967) 1395; *ibid.* 10 (1971) 2451; BRINGI, *Chemistry and Industry*, London (1972) 805; K. C. CHAN, *Phytochemistry* 8 (1969) 1051; H. T. CHEUNG, *Tetrahedron Letters* (1967) 2807; *J. Chem. Soc.* (1968) C, 2686; H. T. CHEUNG & M. C. FENG, *J. Chem. Soc.* (1968) C, 1047; H. T. CHEUNG & C. S. WONG, *Phytochemistry* 11 (1972) 1771; H. T. CHEUNG & T. C. YAN, *Austr. J. Chem.* 25 (1972) 2003; COGGON *et al.*, *J. Chem. Soc.* (1965) 406; *ibid.* (1966) 439; DESAI *et al.*, *Indian J. Chem.* 5 (1967) 523; *ibid.* 9 (1971) 612; DIAZ *et al.*, *Phytochemistry* 5 (1966) 855; GIANNASI & NIKLAS, *Taxon* 26 (1977) 380; GUPTA & SUKH DEV, *Tetrahedron* 27 (1971) 635, 823; HARRISON *et al.*, *J. Chem. Soc.* (1971) C, 2524; HEGNAUER, *Chemotaxonomie der Pflanzen* 4 (1966) 31–44, 446–448, 487–488; KOSTERMANS, *Taxon* 27 (1978) 357; LANTZ & WOLFF, *Bull. Soc. Chim. France* (1968) 2131; MADHAV *et al.*, *Phytochemistry* 6 (1967) 1155; MAGUIRE & ASHTON, *Taxon* 26 (1977) 341–385. — R. HEGNAUER.

*Taxonomy. Historical review.* The first mention of the family of great trees that dominate the lowland and hill-forests of the Far East in European literature is in the diary of MARCO POLO, who recorded visiting Fansur in Sumatra, considered to be the present Baros on the west coast, where the camphor tapped from the hinterland was at that time literally worth its weight in gold. Indeed, up till the mid-eighteenth century it was only the Sumatran camphor which attracted the attention of European travellers. It is mentioned in Dutch literature several times in the mid and late 17th and early 18th century. RUMPHIUS (1755) described the *Arbor Camphorifera* II occidentalis and also mentioned an *Arbor Koring* (1741), which MERRILL (1917) regards as *Dipterocarpus hasseltii* BL. (the name *këruing* and variations of it being the Malay and Indonesian generic name); MERRILL's evidence is meagre however. The camphor tree receives further mention from CHARLES MILLER (1778) who sent a specimen to BANKS from Sumatra.



Meanwhile LINNAEUS had received material from India of a plant that he described as early as 1737 as the genus *Vateria*, and in the 1st edition of *Species Plantarum* (1753) and 5th edition of *Genera Plantarum* (1754) as *Vateria indica*. This he placed in his Class Polyandria Monogynia between *Mesua* and *Thea*, and shortly after *Microcos*, *Tilia*, and *Elaeocarpus*. In 1771 he described *Vatica* in *Mantissa Plantarum*, placing it in Dodecandria Monogynia with *Bejaria* MUTIS. DE JUSSIEU (1789) placed *Vatica* and *Vateria* under 'Genera alternifolia, hinc Guttiferis, inde Aurantiis affinis', with two other genera of undecided affinity — *Allophyllus* (now in *Sapindaceae*), and *Elaeocarpus*. The two then known genera were thus brought together for the first time. In 1824 A. P. DE CANDOLLE placed *Vatica* under *Tiliaceae*, but omitted mention of *Vateria*.

In 1825 SPRENGEL included *Shorea* GAERTN. and *Dipterocarpus* GAERTN. under Polyandria Monogynia, citing *Dipterocarpus* in the *Tiliaceae*. *Vatica* and *Hopea* ROXB. he included in Dodecandria Monogynia following LINNAEUS. In 1828 REICHENBACH placed the then known genera in his *Laurineae d. Pterigiae*, adopting the latter name after CORREA's genus *Pterigium* (1806), in which had been included *Dipterocarpus* and *Dryobalanops* GAERTN. described the year previously.

In 1825 however BLUME had created the family *Dipterocarpeae*, stating that it bore affinities to the *Tiliaceae* in the contorted corolla, and to the *Guttiferae* in the resin ducts, superior ovary, many stamens, and single exalbuminous seed.

LINDLEY (1836) put the '*Dipterocarpeae*' with *Sterculiaceae*, *Mulvaceae*, *Elaeocarpaceae*, *Tiliaceae* and *Lythraceae* into his Alliance *Malvales*, commenting that BLUME had noticed affinities with *Guttiferae*. So did MEISNER (1837) who placed *Dipterocarpaceae* next to *Sterculiaceae*, *Tiliaceae* and the Madagascan *Sarcolaenaceae* (*Chlaenaceae*).

ENDLICHER (1840) on the contrary had put the family with the Class *Guttiferae*, with *Chlaenaceae*, *Ternstroemiaceae*, *Chusiaceae*, *Marcgraviaceae*, *Elatineae*, *Réaumuraceae* and *Tamaricaceae*, thus far separated from *Tiliaceae*. He also erected the African genus *Lophira* BANKS ex GAERTN. (now *Ochnaceae*), which GUILLEMIN (1830) had considered a dipterocarp, into an order of its own, and reduced *Shorea* ROXB. ex. GAERTN. to *Vatica* L. This classification was subsequently followed by LINDLEY (1846). BENTHAM & HOOKER (1862), besides accepting GUILLEMIN's conclusions on *Lophira*, included also *Ancistrocladus* WALL. PLANCHON (1849) had previously put both genera in a group of their own allied to the *Ochnaceae*. BENTHAM & HOOKER resurrected *Shorea*, and maintained the family in their Cohors *Guttiferales*, though stating its affinities to be with the *Tiliaceae* as well as the *Ternstroemiaceae*.

The first complete monograph of the family appeared in A. DE CANDOLLE's *Prodromus* (1868); he enumerated 126 species in 13 genera including *Monotes*; 27 years earlier KORTHALS (1841) had estimated the total known species at only 34. DE CANDOLLE again placed *Ancistrocladus* and *Lophira* in separate families; he further described the first known African dipterocarp as *Monotes africanus*, indicating by its name that the genus occupied an isolated place in the family. He claimed the affinities of *Dipterocarpaceae* to be with *Chlaenaceae* and *Ternstroemiaceae*, with *Lophiraceae* and *Ancistrocladaceae* as intermediate groups.

In 1874 DYER monographed the genera *Dipterocarpus* and *Dryobalanops*. BURCK (1887) made a study of East Indian dipterocarps based in large part on anatomical characters; he created no new genera but united the genera *Pentacme* DC., *Monoporandra* THW. and *Stemonoporus* THW. with *Vateria* and transferred part of the genus *Hopea* ROXB. to *Doona* THW.

HEIM's '*Recherches sur les Diptérocarpacées*' (1892) remains to this day the most detailed study of the whole family. Though he frequently made anatomical studies of leaf, petiole, twig and fruit, he gave particular weight to the characters of the stamens, the embryo and to the 'caractéristique' (the arrangement of the vascular bundles as seen in transverse section in the petiole at the umbo). His system suffered because he was working at a time when herbarium collections were quite inadequate in quality and in numbers for his task. The result was unfortunate; whereas BURCK five years previously had recognised only 10 genera, HEIM maintained 30, in 8 series and 2 subseries; of these 13 genera were new though based altogether on only 17 species, of which 11 were described from single herbarium sheets. The genus *Cotylelobiopsis* HEIM, for instance, was described from a single sterile sheet in which the anatomy of the petiole was found to be unique in the family; the specimen, which is lost, appears to represent fallen leaflets of *Pseudosindora palustris* SYM. in the *Leguminosae*. *Cotylelobium melanoxylon* was represented under three binomials, each based on a single specimen. Of the 4 species recognised by HEIM in his genus *Richetia*, SYMINGTON (1933: 153)

later correctly reduced 3 to a single species already described by BURCK. The 4 genera united under *Vatica* by BURCK were redivided and placed in 2 series; *Monotes* DC. was removed to the *Tiliaceae*.

HEIM promised a more complete monograph at a later date, but in 1895 the *Dipterocarpaceae* were treated by BRANDIS and GILG for the Pflanzenfamilien; later in the same year BRANDIS also published an 'Enumeration of the Dipterocarpaceae . . .', based on the specimens at Kew and the British Museum. *Monotes* was reunited with the *Dipterocarpaceae*, while none of HEIM's genera were accepted and few of his species. They maintained but 16 genera, being a return to DE CANDOLLE's generic concept, with the addition of *Balanocarpus*, *Cotylelobium*, *Parashorea* and *Isoptera*, described subsequently to 1868; the reduction of *Petalandra* HASSK. to *Hopea*; and the maintenance of *Stemonoporus* separate from *Vatica*, under which name it had been reduced by DE CANDOLLE. They recognised 5 tribes in *Dipterocarpaceae sens. str.* following BRANDIS. Later GILG (1899) placed the African dipterocarps in a separate subfamily. His account in the 2nd edition of the Pflanzenfamilien (1925), which is the most recent of the whole family, is with this exception mainly a reprint of the 1895 account. In 1941 SYMINGTON described the genus *Upuna*; this genus necessitates a redefinition of BRANDIS's tribes, and this has been discussed by me (1978). Two tribes are now recognised in *Dipterocarpaceae* on the basis of the calyx, resin canal distribution and basic chromosome number. One includes BRANDIS's tribe *Shoreae* and *Dryobalanops*, while the remaining genera are contained in the other.

*Subdivision of the family.* The family is subdivided into three subfamilies (MAGUIRE & ASHTON, 1977), which can be distinguished as follows:

1. Anthers basifixed; pollen tricolpate; exine 2–3-layered. Sepals, if ampliate, then generally conspicuously unequal with 2/3 becoming alate in fruit. Ovary (2/3)-celled, each cell with 2 ovules. Wood, leaves and ovary with resin or secretory ducts; wood rays multiseriate. 13 genera: tropical Asia and Malesia . . . . . **Dipterocarpoideae**
1. Anthers basi-versatile; pollen tricolporate; exine 4-layered. Sepals equally accrescent, papyraceous. Ovary (2/3)–4–(5)-celled, each cell with 2–4 ovules. Wood, ovary and, commonly, leaves without resin or secretory ducts.
  2. Petals longer than sepals. Anthers little or deeply basi-versatile, connective little or moderately projected as an apical appendage. Ovary 3–(4)-celled, each cell with 2 ovules. Wood rays dominantly uniseriate. 2 genera: tropical Africa and Madagascar (1 species). **Monotoideae**
  2. Petals shorter than sepals. Anthers deeply basi-versatile, connective conspicuously projected as an apical appendage. Ovary 4 (5)-celled, each cell with 4 ovules. Wood rays dominantly biseriate. 1 genus: tropical America . . . . . **Pakaraimoideae**

Recently KOSTERMANS (1978) suggested that *Pakaraimaea* would belong to *Tiliaceae* and might even be congeneric with *Schoutenia*. This opinion rests on a superficial comparison and his arguments are in part erroneous, e.g. on pollen and wood anatomy. It is now definitely proved that *Pakaraimaea* belongs to *Dipterocarpaceae* (MAGUIRE & ASHTON, 1980).

*Subdivision of the Dipterocarpoideae.* Two tribes are recognised:

1. Fruit calyx lobes valvate at base, calyx cup vasculature not overlapping in flower. Vessels usually solitary, resin canals scattered. Basic chromosome number (probably)  $x=11$ : *Vateria*, *Vateriopsis*, *Stemonoporus*, *Vatica*, *Cotylelobium*, *Upuna*, *Anisoptera*, *Dipterocarpus*. **Tribe Dipterocarpeae**
2. Fruit sepals expanded and imbricate at the incrassate cupped base, calyx cup vasculature  $\pm$  overlapping at margin in flower. Resin canals in tangential bands. Basic chromosome number (probably)  $x=7$ : *Dryobalanops*, *Parashorea*, *Hopea*, *Neobalanocarpus*, *Shorea*. **Tribe Shoreae**

The two large genera *Hopea* and *Shorea* differ in a single character of the fruit calyx, indiscernible in those species where the sepals are short and equal and which are assigned to their respective genera according to the flora characteristics by which their sections are defined. *Neobalanocarpus heimii*, with unique floral morphology and short subequal fruit sepals, is thus unassignable but in several ways intermediate.

*Generic and infrageneric delimitation* (for a review see ASHTON, 1979a). A wide range of characters of flower and fruit, leaf, bark and wood are available for distinguishing between dipterocarp genera.



In tribe *Dipterocarpeae* the Malesian genera are marked by their internal uniformity and a unity imposed by a large number of anatomical and morphological characteristics. This is particularly so of the large genus *Dipterocarpus*. *Vatica* and *Cotylelobium* differ principally in flower and wood structure, which are nonetheless rather uniform intragenerically; but it is remarkable that the two distinctive forms by which the two sections of the large genus *Vatica* are distinguished are identically repeated in *Cotylelobium* with a mere 5 species of which one, *C. lewisianum* (TRIM. ex HOOK. f.) ASHTON of Ceylon, has short, equal, reflexed fruit sepals and a thick-walled, loculicidally sutured pericarp. The monotypic *Upuna* is also very well distinguished, as is *Anisoptera* which nonetheless contains two uniform sections differing only in floral structure.

The remaining genera pose more or less considerable problems of definition. *Dryobalanops* and *Parashorea* are characterised by subequal typically long fruit sepals and are distinct anatomically and in leaf venation. *Parashorea* shares alone with *Dipterocarpus* in the family its plicate vernation; *Dryobalanops* has unique leaf venation; each are further distinguished by a constant and characteristic floral and embryological structure. The remaining 253 Malesian species can be subdivided into 18 groups, of varying size and distinctiveness but generally great internal uniformity in diagnostic characters, on the basis of the androecium. In some, such as the large sections *Anthoshorea* and *Richetioides* (also *Doona*, endemic to Ceylon) of *Shorea*, these characters are correlated with equally constant and distinctive bark, wood, embryo and other characters. In others, such as *Hopea subsect. Hopea*, *Neobalanocarpus* and *Shorea sections Shorea*, *Pentacme* and *Neohopea* significant differences in floral, and in the case of *Hopea* fruit morphology, occur to distinguish them from one another, yet all share an essentially uniform leaf, wood and bark anatomy which often makes them impossible to assign in the field when sterile. The same is so of the wood of *Shorea sections Rubella*, *Brachypterae*, *Pachycarpae* and *Mutica*, though here each possesses distinctive bark manifestations, and indeed sections *Brachypterae* and *Rubella* more closely resemble in floral structure *sect. Anthoshorea* though differing significantly in wood and bark anatomy. We have here therefore a constellation of taxa, the most distinct of which approach the status of genera equivalent to, for instance, *Vatica* and *Cotylelobium*, the least not meriting more than subsectional status, yet all clearly part of a greater coherent group. Ideally all might be included in a single common genus *Shorea* of many sections, yet as generic definitions were formerly based on fruit calyx morphology the sections are presently included in two major genera, *Shorea* and *Hopea*, differing only in a single character, the number of aliform fruit sepals. Species therefore with short subequal fruit sepals — regarded in these taxa as a derived condition — are assigned to a genus according to their sectional characteristics. *Shorea isoptera*, however, of the monotypic *sect. Neohopea*, has 5 aliform subequal fruit sepals and unique floral morphology and is only assigned to *Shorea* owing to its overall resemblance in bark, wood and habit, to members of the type section; it would be undesirable to create a new genus for a single species in many respects intermediate between such similar genera. *Neobalanocarpus* likewise has short subequal sepals and unique floral morphology; it appears, on leaf characters, wood anatomy, biochemistry and habit to come closest to *Hopea*, but is kept separate for historical reasons and as perhaps the most celebrated forest tree of Malaya. *Hopea* and *Shorea* nevertheless are more or less recognisable as entities, the former being generally smaller trees and frequently stilt-rooted; foresters in tropical Asia would damn the botanist who undertook 86 nomenclatural changes in the quest of a spurious taxonomic ideal, and so would I.

*Specific and infraspecific delimitation* (for a review see ASHTON, 1978). The subfamily is mainly (though not exclusively) composed of morphologically well defined species in which with experience delimitation should present no difficulty. A main source of misinterpretation has been owing to the great difference in vegetative characters between the young and mature stages and hence to the lack of field experience on the part of many monographers. The early collectors frequently did not have the opportunity to collect leaf specimens from the crowns of the giant trees, and instead collected fallen fruit and saplings. Later authors were unable to establish the true identity of species described from such material, and redescribed material from the mature tree, when it became available, as a new species. This confusion is accentuated by the uniformity of flower and fruit within some sections, and the great value of leaf, tomentum and bark characters in diagnosis when the variability during the life of each species is understood.

Size differences are not by themselves sufficient to distinguish species, neither are therefore

differences of leaf size and shape together. Differences in fruit size are likewise unreliable and rarely correlate with other characters; collections from one tree in different years often exhibit great variation. A consistent discontinuity in leaf size, where correlated with differences in androecium or gynoecium, in qualitative (but not quantitative) characters of indumentum, with qualitative characters of the twig or stipule or with a discontinuity in the range in the number of leaf nerves does constitute an adequate criterion for separating species however.

In the absence of any possibility of proving interfertility taxa are designated as subspecies in the following circumstances:

(1) Where discontinuities occur in the range of quantitative characteristics of parts, or tomentum distribution and density, but no qualitative difference exists.

(2) If a series of clearly defined, but closely similar, taxa exist which occupy distinct geographical areas, even if intermediate forms are not known. The subspecies of *Dipterocarpus conformis* and *Shorea macroptera* serve as examples.

(3) If a series of closely similar taxa occupy distinct, but greatly overlapping, areas and in at least one area show intermediate forms. In *Shorea parvifolia*, for example, two subspecies are recognised with greatly overlapping ranges; a third form (the 'Perak form' of SYMINGTON, 1943) occurs in Malaya and in N.E. Borneo which possesses characters intermediate between the other two and may represent a hybrid between the two subspecies.

By contrast, though several forms of *Shorea pinanga* occur, apparently with different ecological ranges, the vast number of collections of this species show a bewildering range of more or less continuous variation, made more confusing as the varying characters, leaf size, number of nerves, and tomentum, also change much with the age of the plant; here subspecies are therefore not recognised.

Polymorphism of the latter type is unusual, tending to occur within Malesia in species within groups (such as *Shorea* sect. *Pachycarpae* and the New Guinea *Hopeas*) consisting of large numbers of species confined to a single geographical area, possibly undergoing active diversification at present. It is characteristic also of those species (e.g. *Shorea siamensis*, *Dipterocarpus obtusifolius*, *D. tuberculatus*, *Anisoptera costata*, and *A. thurifera*) which occur in both seasonal and non-seasonal climates and which become gregarious and regenerate freely in secondary forest or fire-savanna. Here too the only well authenticated hybrid populations between markedly dissimilar species of *Dipterocarpus* are known: examples are recorded by FOXWORTHY from Luzon, by KERR (1914) from Thailand, and by PARKER (1927) from Burma.

Notes are included after the descriptive texts, which elaborate on complex patterns of morphological variation in these taxa, including certain sections of *Shorea*, in which they prevail.

The apparently trivial yet remarkably constant differences which distinguish the multitude of species of non-seasonal western Malesia, their morphological uniformity as a rule, their tendency (see below, under evolutionary trends) in that region towards reduction of staminal size and number, their occasional flowering and the existence of polyembryony and triploidy open the possibility that apomixis may have become general under these climatic conditions. FEDOROV (1966, 1977), ASHTON (1969, 1977, 1978) and MEIJER (1974) have discussed the problem of dipterocarp speciation, but conclusive evidence is only now beginning to arrive (KAUR *et al.*, 1978).

*Evolutionary trends within the family* (for recent reviews see MAGUIRE & ASHTON, 1977; ASHTON, 1979b). *Fruit calyx*. Without resorting to theories to decide which characters are primitive, it is safe to assume that departure from regular actinomorphy in the dipterocarp flower must represent an advanced condition. This, as the family name suggests, occurs in the calyx following anthesis. The genera always possessing equal fruit sepals are the American subfamily *Pakaraioideae* and the entire African subfamily *Monotoideae*, the short-sepalled *Vateria* L. of Ceylon and S. India, *Vateropsis* of the Seychelles, *Stemonoporus* of Ceylon, and *Dryobalanops* with either short or aliform fruit sepals. *Vatica* sect. *Vatica* is also characterised by short equal fruit sepals, whereas in sect. *Sunaptea* they are unequal; species in the small genus *Cotylelobium* possess fruit identical to those of the latter section but for *C. lewisianum* (TRIM.) ASHTON of Ceylon in which they are as in the type section. In *Dipterocarpus*, *Parashorea*, and all sections of *Shorea* and *Hopea*, however, individual species occur also with short subequal fruit sepals: the evidence suggests that in these latter genera this condition is a secondary reversion: of the 66 species among these genera with short subequal sepals (3 in *Parashorea* and *Dipterocarpus*, *Neobalanocarpus*, 19 in *Hopea*, and 40 in



*Shorea*) all but 8 are rare local endemics or confined to the island or country in which they occur. Of the 7 relatively widespread species all but 2 are typically riverine or swamp species; this fact, especially significant in a family usually characteristic of well drained land, suggests a secondary adaptation to water dispersal. Further, the group among these genera where the short-sepalled condition is most prevalent, and in which the non-riverine widespread species *Shorea multiflora* and *S. balanocarpoides* occur, is *sect. Richetioides* of *Shorea*. In the unique leaf nervation, the great restriction in most species of the tomentum so characteristic of the family, and in the characteristic reduction of the number of pollen-sacs from the usual 4 to 2, they give every indication of being an aberrant advanced group; this is supported by phytogeographic evidence, the section being large but confined to Malaya, Sumatra, Borneo and the Philippines. Again, some of these local endemics bear close resemblances to unequal-sepaled species of widespread distribution. As examples from many, *Shorea hiawak* and *S. usahi*, both known only from northern Borneo have close affinities with *S. maxwelliana* and *S. laevis* respectively, both of which range through Borneo, Sarawak and Malaya.

According to CORNER (1949) an aril in an indehiscent fruit is a relic from a dehiscent state. SYMINGTON (1941) described a vestigial aril-like structure in *Upuna*, and considered that the 'cupule chalazique', which was observed by HEIM (1892) in dried material of *Stemonoporus* spp. as a cup-shaped process from the funicle, might also be an aril; this structure also occurs in *Vateriaopsis*, and the highly vascularised placenta of *Pakaraimaea* may be homologous. No known dipterocarp has fruit dehiscent on the tree, but in *Marquesia*, *Stemonoporus* and *Upuna* the pericarp of the fallen fruit splits along three loculicidal sutures at germination and in the first two there is sometimes active recurving of the pericarp apex. The mature fruit of *Pakaraimaea* is unknown, but as the pericarp is extremely thin along its five angles it would appear to be capsular. Such sutures occur also in *Vateria*, *Stemonoporus*, *Dryobalanops oblongifolius* and in *Vatica* *sect. Vatica*. In other *Dryobalanops* and some *Hopea* sutures are not discernible but the pericarp often splits into 3 equal valves at germination; the pericarp of other dipterocarps is split more or less irregularly by the expanding embryo. Of the taxa with loculicidal sutures only *Upuna* has unequal fruit sepals; conversely all the natural groups within the Asian subfamily which have equal sepals as a constant character are included among those with sutures, and of these all but *Dryobalanops* have fruit sepals generally rotate or reflexed and shorter than the ripe seed.

Within *Dipterocarpoideae* there appears also to have been a reduction in the size of the seed and thickness of the pericarp. In *Vatica* *sect. Sunapteae* the fruit is small, the pericarp thin-walled, and the sutures obscure or absent. In the type section of *Vatica* most species have large fruit with thick-walled pericarps. Some, such as *V. vinosa*, *V. pallida*, *V. flavida* and *V. lobata* have fruit as small as those of *sect. Sunapteae*; these are further characterised by their comparatively thinner pericarp and obscure sutures. All however are local endemics except for the riverine *V. venulosa* which may well have extended its range rapidly and recently by water dispersal; hence they are unlikely to be ancient species. In other genera the same correlations prevail with the exception of the rather isolated genus *Dipterocarpus*, in which all the species have a large indehiscent nut enclosed in a calyx tube, the clearly recent and still diversifying *sect. Pachycarpae* of *Shorea* in which the largest fruited species are adapted to water dispersal, and a few other isolated *Shorea* species (e.g. *S. geniculata*) where the large fruit appears to be recent rather than ancient, but whose adaptive significance is not understood.

*Stamens*. The number of dipterocarp stamens may vary from 5 to c. 105. The most widespread number is 15; 10 occur in some *Hopea*, some species of *Shorea* *sect. Richetioides* and sometimes in abnormal flowers in *sect. Mutica*. The two *Stemonoporus* species formerly in *Monoporandra*, and a single Bornean species of *Vatica*, possess 5 only. Genera with many stamens as a characteristic are *Pakaraimaea*, *Marquesia*, *Monotes*, *Vateria*, *Upuna*, *Dryobalanops* and *Dipterocarpus*; it is usual also in the type section of *Anisoptera*, and *sect. Anthoshorea*, *Ovalis* and *Shorea* of *Shorea*. Phytogeographical evidence within Asia lends support to the suggestion that the primitive type had numerous stamens, and that genera with 15, 10 or 5 stamens reached these numbers by reduction. *Vateria* occurs in southern India, Ceylon, and the Seychelles whereas *Stemonoporus*, with 5 or 15, is endemic to the wet zone of Ceylon. *Anisoptera* *sect. Glabrae*, with 15 stamens, ranges from Burma and Indo-China through Malaya to Borneo, whereas *sect. Anisoptera* with many stamens occurs from Burma and Indo-China through Malaya and Sumatra, Borneo, the Philippines, and across

Wallace's line to New Guinea. Within *Shorea*, though the monotypic and probably advanced *sect. Ovalis*, with many stamens, occurs in Malaya, Sumatra and Borneo, the large *sect. Shorea* and *Anthoshorea* (with 15-~ stamens) are considerably more widespread than the equally large *sect. Mutica*, *Richetioides* and *Brachypterae* (typically with 10-15 stamens with the exception of two species). The former occur east of Borneo and the Philippines, and through India to Ceylon; the latter are confined to the everwet region of western Malesia with the exception of one species in the Moluccas. In this case a clear pattern emerges of a reduction of staminal number among local endemic species of the everwet zone, especially in the geologically recent region of lowland Borneo. The widespread species, often of the seasonal tropics and including the American and African subfamilies, retain the primitive condition. This pattern is most clearly seen within those groups in which staminal number is variable.

*Wood anatomy*. GOTTWALD & PARAMESWARAN (1966) independently regard a characteristic type of multiple perforation, along with different stages of disintegration of the plate-membrane, in vessels of *Vateria* and certain species of *Vatica sect. Vatica*, and of spiral thickenings in vessel and parenchyma walls in the latter, as clearly indicating the primitive condition of the wood of these groups in the Asian subfamily. However, the aberrant type of multiple perforation plate, sporadically occurring in the woods of these taxa as well as the spiral thickenings to the vessel walls can—in the opinion of P. BAAS (personal comm.)—equally well be regarded as unusual specialisations in the *Dipterocarpaceae* of no phylogenetic significance whatsoever (*cf.* the occurrence of similar aberrant perforation plates in the wood of apple and pear trees, which cannot be interpreted as an argument that *Malus* and *Pyrus* are primitive in the *Rosaceae*!). On the basis of xylem anatomy *Stemonoporus* is closely allied with them, whereas *Upuna* is in many respects intermediate between them and *Anisoptera*, *Dipterocarpus* and *Cotylelobium*. *Shorea*, *Parashorea* and *Hopea* differ from other *Dipterocarpoideae* in their tangentially arranged resin canals (diffuse in other genera). Their conclusions on phylogenetic affinities are closely in accord with those derived from other evidence: "The evolutionary status within the (sub)family is characterised by a concentration of the non-advanced characters in the taxa outside the tribe *Shoreae*; thereby the genus *Dryobalanops* appears to form the connecting bridge. As a consequence, it is seen that in the extreme small south-west area of distribution a larger number of genera are present with relatively primitive characters than in the large Malesian region, usually regarded as the centre of origin of the family."

*Petiole anatomy*. The complex petiolar vascular supply, characteristic of many genera in the family, reaches its greatest elaboration in *Dipterocarpus*, *Vateria*, and the type sections of *Shorea* and *Hopea*. The supply is reduced to 3 peripheral bundles in many *Hopea sect. Dryobalanoides* and is relatively simple in the other sections of *Shorea*, but also in the putatively primitive *Vatica* however. It seems that the primitive condition was the complex one, but generalisations are difficult as the complexity also varies much according to the size of the petiole: large-leaved *Dipterocarpus* and *Shorea* (including species of *sect. Pachycarpae*) have very much more complex systems than small-leaved, and genera with slender petioles such as *Dryobalanops* and *Anisoptera* have simpler systems than *Dipterocarpus*, though more complex than most *Hopea* and *Shorea* (see *e.g.* MAURY, 1978). If the complex is more primitive, then *Hopea sect. Hopea* is nearest to the archetype in that genus. This is supported by the leaf nervation, which most nearly approaches the type typical of other genera, and by the bark morphology, which WHITMORE (1960) has shown to differ in no important way from that of *Shorea sect. Shorea*; these two sections both appear to be primitive in their genera, hence more nearly than others resemble the common ancestor and thus one another. They further both share a wider distribution than other sections in their respective genera.

*Family affinities*. Up to the time of BRANDIS's Enumeration (1895) *Dipterocarpaceae* had been variously associated with *Aceraceae* (GAERTNER), *Lauraceae* (REICHENBACH), *Theaceae* *Ternstroemiaceae* (ENDLICHER, A. DE CANDOLLE), *Malvaceae* (LINDLEY), *Tiliaceae* (A. P. DE CANDOLLE, BLUME, SPRENGEL, MEISNER, LINDLEY, HEIM, BRANDIS, and GILG), *Sterculiaceae* (HEIM), and *Guttiferae* (DE JUSSIEU, BLUME, ENDLICHER, LINDLEY, BENTHAM & HOOKER, and HEIM). Since ENDLICHER the family has been more or less constantly put in the *Guttiferales*, this clearly allying it with *Guttiferae* and *Theaceae* and separating it from *Tiliaceae* in the Order *Malvales*. It should be remarked, however, that BENTHAM & HOOKER placed *Chlaenaceae* next to *Dipterocarpaceae* in cohorts *Guttiferales* which was immediately followed by cohorts *Malvales*, the only difference being



in the aestivation. This classification has been subsequently followed by BESSEY (1915), HUTCHINSON (1926), WETTSTEIN (1935), and PULLE (1950). LINDLEY (1836) at first placed *Dipterocarpaceae* in his Alliance *Malvales*, but in 'The Vegetable Kingdom' (1846) followed ENDLICHER's (1840) transfer to *Guttiferales*. HEIM (1892) claimed the affinities to be mainly with the *Tiliaceae*, but the only subsequent author to adhere to this view was HALLIER f. (1912) who placed them in his Order *Columniferae*, with marked affinities with *Tiliaceae* and *Elaeocarpaceae*. The *Columniferae* he considered to be derived from 'Protoberberidaceous' ancestors, and far removed from the *Guttiferales*, with Dilleniaceous ancestors.

The *Ancistrocladaceae* have been associated previously by many authors with the *Dipterocarpaceae* owing to the superficial similarity of their fruit with its 5-merous perianth, persistent aliform imbricate sepals, and the embryo with folded cotyledons enclosing the radicle and with the testa intruding between the folds. The unilocular ovary with single ovule, the leaf-nervation, scandent habit, presence of thorn-hooks, and anatomy indicate to me that the affinity is not close.

*Dipterocarpaceae* share with *Guttiferae*, *Theaceae*, and also *Tiliaceae* centrifugal stamens, so that if CORNER's (1946) contention is correct all these families share a common ancestry, though the character gives no indication to which family the dipterocarps are most nearly associated.

With the *Theaceae* are shared the 5-merous perianth, imbricate persistent sepals, frequently contorted corolla, numerous hypogynous stamens, 2-celled anthers generally dehiscing longitudinally, superior generally 3-celled ovary with frequently 2 ovules per cell, axile placentation, and seeds with scanty endosperm. The absence, in *Theaceae*, of stipules, stellate, tufted or glandular hairs, connectival appendages, mucilage cells and usually resin canals and the frequently dentate leaves, indistinct leaf nervation, and short-sepaled fruit calyx, readily distinguish the two families.

It is the presence of intercellular resin canals which has principally led systematists to associate the *Dipterocarpaceae* with the *Guttiferae*; other characters in common are the vertically transcurrent nervation, the usually many hypogynous stamens, usually contorted corolla, usually racemose inflorescence, and persistent calyx with usually imbricate sepals. The absence of endosperm, which has frequently been cited as a factor allying the two, but not *Tiliaceae*, is erroneous; HEIM (1892) and others have already shown that some species in several groups retain endosperm at maturity of the seed.

Of the characters shared with the *Guttiferae*, those of the androecium are shared also with *Theaceae* and *Tiliaceae*, as also the contorted corolla and, in many, the nervation; the inflorescence in the *Tiliaceae* is also frequently racemose while conversely *Upuna*, *Monotes*, some *Vatica* and one *Parashorea* share the cymose inflorescence typical of most *Tiliaceae*; tribe *Dipterocarpeae* possesses a subvalvate flower calyx; in *Tiliaceae* the calyx is always valvate in flower. The resin canals are therefore the only character in common with the *Guttiferae* that are not also shared with some members of the *Tiliaceae*. Canals are confined to the medulla in the *Dipterocarpaceae*, unlike the *Guttiferae*.

*Guttiferae* differ notably in the absence of stellate or glandular hairs, the general presence of a hypodermis, the papillose lower epidermis, absence of stipules, frequently unisexual flower, absence of an appendage to the connective, absence of aliform fruit sepals, and opposite leaves (the alternate-leaved South American genera *Caraipa*, *Kielmeyera*, *Haploclathra*, *Marila* and *Mahurea* are now considered to belong to the *Theaceae* or *Bonnetiaceae*). The leaf nervation in *Guttiferae*, with many indistinct lateral nerves, is very dissimilar from the prominent pinnate nervation of *Dipterocarpaceae*; *Dryobalanops*, and *Hopea* sect. *Dryobalanoides*, which are exceptional in sharing a nervation superficially similar to *Guttiferae*, cannot be considered primitive types in the family.

With the *Tiliaceae* the *Dipterocarpaceae* share the same stamen characters; the closely related *Elaeocarpaceae* bear connectival appendages similar to those of many dipterocarps; the genera *Grewia*, *Pentace*, and *Schoutenia*, inter alia, possess persistent, expanded, and wing-like fruit sepals. Characters shared with *Dipterocarpaceae* and *Tiliaceae* but not the previously discussed families are mucilage canals in cortex and cells in the epidermis of many, the mixed uni- and multi-seriate rays (except *Monotes*), the arrangement of bast fibres into outwardly tapering wedges, and the presence of a complex indumentum which may include single or tufted uni-cellular hairs, short or long stalked multicellular glandular hairs, and unicellular peltate or stellate hairs.

The floral vascular supply strikingly confirms the Malvalian allegiance (see VAN HEEL, 1966). CORNER (1976) has further found that the seed coat conforms to that of *Malvales*. These facts argue

against the family being included in the *Guttiferales* as opposed to the *Malvales*. The single anomalous character of the resin canals is absent from the subfamily *Monotoideae* and *Pakaraimoideae*. The *Elaeocarpaceae* are virtually always devoid of mucilage cavities; moreover the suggestion that elongate mucilage cells have phylogenetically developed into resin canals lacks any logical structural basis. The prominent pinnate nervation of dipterocarps, and frequently geniculate petiole, is so similar to that of the *Elaeocarpaceae* that leaves on the forest floor are sometimes almost unassignable. In the *Tiliaceae* the basal pair always send off lateral branches on the outer side; this is also found in some dipterocarps, e.g. in *Shorea robusta*, *Dipterocarpus nudus* and *D. stellatus*, and abnormally sometimes in other species. The dipterocarp leaf nervation, usually entirely transcurrent owing to the presence of columns of sclerenchyma, as in *Guttiferae* and *Ochnaceae*, is found sometimes also in *Tiliaceae*.

The genus *Monotes*, which with the genus *Marquesia* constitutes the African subfamily *Monotoideae*, was transferred to *Tiliaceae* by HEIM (1892); indeed *Marquesia excelsa* R.E.FR. was originally named (though not published) as a *Schoutenia*. The principal characters in which the *Monotoideae* differ from *Dipterocarpoideae* are the uniseriate rays, absence of resin canals but presence of elongate medullary mucilage cells, subversatile anthers with elongate slender filaments, and the tricolporate pollen with 4-layered exine. Of these all but the first are common in the *Tiliaceae*. The imbricate sepals, trilocular (in *Marquesia* incompletely septate as in *Dryobalanops*) ovary with two ovules in each cell, and pinnate nervation with unbranched basal nerves, are typical of *Dipterocarpaceae*. The cymose inflorescence is unusual in *Dipterocarpoideae*, but is widespread in *Tiliaceae*. BANCROFT (1935) examined the wood anatomy of *Monotoideae* and found it to be quite distinct from both families; this is confirmed by GOTTFELD & PARAMESWARAN (1966). The general facies is more similar to *Dipterocarpoideae*, but differences were considered by them sufficient to constitute a separate family. Resin was present in the wood as in *Dipterocarpoideae*, though not in intercellular canals. *Monotoideae* are thus a clearly defined group.

The recent discovery of a dipterocarp subfamily in the Guyana Highlands (MAGUIRE *et al.*, 1977) strengthens this link, for *Pakaraimaea* shares the stamen, pollen, calyx and many wood characters of *Monotoideae* (though the wood rays are predominantly biseriate), yet has a generalised Malvalian 4-5-celled ovary, each cell of which is 2-4-ovulate; in several respects therefore this South American relict must be regarded as archaic within the family.

Another family, *Sarcolaenaceae* (*Chlaenaceae*), endemic in Madagascar, has often been claimed to be a close relative of *Dipterocarpaceae*. MEISNER (1837) and BENTHAM & HOOKER (1862) had already placed them close to that family; so did HUTCHINSON (1926) and METCALFE & CHALK (vol. 1, 1950, 22). According to the studies of CAVACO (1952) and CAPURON (1970) they exhibit a far greater diversity than mostly admitted in handbooks, covering almost all characters of *Dipterocarpaceae*, in particular those of *Monotoideae*.

MAGUIRE *et al.* (1977) have pointed out that this family too has the indumentum and complex petiolar anatomy characteristic of *Malvales*, but shares with *Dipterocarpaceae* alone in this order an imbricate calyx, 3-celled ovary (here *Pakaraimaea* is the exception), and absence of paired basal leaf nerves; they also indicate that a distinct leaf nervation with looped intramarginal nerve, and a 1-2-layered hypodermis are shared by genera in both families; DE ZEEUW (*l.c.*, 368) considered that the wood anatomy more closely resembles that of *Monotoideae* and *Pakaraimoideae* than theirs does even to *Dipterocarpoideae*; a resemblance to Tiliaceous wood exists too, but is more remote.

A preliminary anatomical study of *Eremolaena boinensis* also confirmed the presence of tufted hairs with a rosette of glandular hairs at their bases and possibly of peltate scales on the twigs. The anomocytic stomata, the bark anatomy, and the occurrence of mucilage cells in the mesophyll, pith and primary cortex together with the indumentum points to both *Tiliaceae* as well as *Dipterocarpaceae* affinities. In the wood anatomy, however, *Sarcolaenaceae* much more resemble *Monotoideae* of the *Dipterocarpaceae* than *Tiliaceae*; ray and fibre type agree well and most important of all *Eremolaena* shows vested pits: a very important taxonomic character found in all *Dipterocarpaceae* but not in *Tiliaceae* or other *Malvales*. METCALFE & CHALK say that the *Dipterocarpaceae* and *Sarcolaenaceae* differ by the absence of resin ducts in the pith of *Sarcolaenaceae*, but *Monotes* and *Marquesia* have not been examined in this respect, and could equally well miss these. Though *Sarcolaenaceae* and *Dipterocarpaceae* could be considered to represent different families, they appear to be distinctly allied at a higher level and could well belong



or have been derived from the same ancient Tiliaceous matrix in Gondwanaland (MAGUIRE *et al.*, 1977).

*History of the Dipterocarpaceae.* In concluding the preceding chapters it is tempting to speculate about the origin, dispersion, and development of this group in time.

The overriding contemporary concentration of dipterocarp species diversity of West Malesia prompted authors (from MERRILL, 1923, to MEHER-HOMJI, 1979) to suggest a Far Eastern origin for the family. The fossil evidence is ambivalent; PRAKASH (1972) and LAKHANPAL (1974) discussed the fossil history of *Dipterocarpaceae*. PRAKASH assumed an Asian origin for *Dipterocarpoideae*, but LAKHANPAL leaned toward a Gondwanic origin of the whole family, an idea originating with CROIZAT (1952). AUBRÉVILLE (1976) argued for a biphyletic origin, with *Dipterocarpoideae* of Laurasian, and *Monotoideae* of Gondwanic provenance.

Accepting the principle of continental drift one could rather easily imagine, on the basis of comparative anatomy and morphology, a southern Gondwana origin with the development of a 'Dipterocarpaceous ancestral stock' in a Gondwana-continent, possibly in the Upper Cretaceous. This implies of course a tropical to at least subtropical climate in a period long after the Angiosperms originated and had already strongly diversified.

The subsequent Atlantic split then provided the South American continent with a section of the dipterocarps of which *Pakaramaea*, a generalised and in this sense archaic form within the family, as the sole survivor; the reason why this West Gondwana offshoot did not lead to a separate diverse and derived branch must remain obscure.

Also primitive in several respects was the other offshoot *Monotoideae*, which remained in a central position in tropical Africa where it is now represented with 2 genera and *c.* 40 *spp.* (with one which may have recently invaded Madagascar). Possibly from this same ancestral stock another plant family developed in Madagascar, *viz* *Sarcolaenaceae* as it seems *Monotoideae* are their closest allies.

The most successful 3rd offshoot was the *Dipterocarpoideae* of which the ancestors inhabited the eastern tropical part of Gondwanaland. According to trustworthy fossils they were at least present formerly in East Tropical Africa while *Vateriopsis* is a genus still found in the Seychelles, a relict on a surviving peak of the submerged part of the Deccan plate. Whether the Deccan plate sailed from S.E. Gondwanaland to the Laurasian shores of the Tethys with the dipterocarp pilgrim fathers to S.E. Asia on board remains to be confirmed by fossil evidence from the late Cretaceous or early Oligocene of India and East Africa, but the distribution and phylogeny of *Vateriopsis*, *Vateria* and *Stemonoporus* strongly suggest that it did.

Probably not long after the *Dipterocarpoideae* reached S.E. Asia, which must have been by the Oligocene according to the pollen records in Borneo, they rapidly diversified, as still shown by the present wide representation and endemism of supraspecific taxa in Ceylon. In all probability they were already rain-forest constituents, as most are at present in Ceylon, as they would also have been subject to oceanic (if more windy) conditions on a hypothetical rafted Indian subcontinent.

Migrating eastwards through S.E. Asia they finally invaded the Malesian area in the early Tertiary, as testified by the Oligocene pollen record in Borneo. By the Miocene they had become common, as shown by the abundance of fossil wood and their appearance as a regular constituent of the pollen record, and they have presumably retained this position till the present day.

In continental S.E. Asia they have come to thrive in both the everwet and seasonal regions. By their capacity for gregariousness and high stature they have overwhelmed the mixed lowland rain-forest and created the present majestic forest profile of the large islands of West Malesia.

The Philippines seem to have been close enough, and I would assume at least once connected with western Sundaland, to receive a generous supply. I do not believe that we can conclude from dipterocarp geography alone, though, that these islands have been intermittently invaded by dipterocarps as MERRILL (1923) discussed at length, though this would be compatible with the geomorphological instability of the region bordering the east of Wallace's line.

The land-connections between the Philippines and the Moluccas and New Guinea must have been similarly inadequate and intermittent and apparently did not allow *Parashorea*, *Dipterocarpus* *etc.*, to enter the East Malesian Province. The 4 genera in this province (Celebes, Moluccas, New Guinea) are: *Anisoptera*, *Hopea*, *Shorea* and *Vatica*. I accept DIELS's contention (1922) that the few dipterocarps of New Guinea represent a younger element in its flora, probably derived from the

northwest by way of the Philippines, Celebes and Moluccas. It is noteworthy that in New Guinea *Hopea* shows fairly high and probably young speciation.

In South Malesia there are only 5 genera present in Java with few (10) species, and in the western Lesser Sunda Is. only 2 genera with 3 *spp.* This paucity is ascribed to several causes; the volcanicity and long period of human habitation in the moist humid lowlands of Java precluded intensive collection there by the early Dutch botanists; further east poor land connections played a part, though much of the present distribution can be explained by the dry climatic conditions in the lowlands, for the petering out of the family eastwards is correlated with increasing drought; there appears to have been no capacity for development of drought-resisting species such as happened in continental S.E. Asia. It cannot therefore be safely concluded that South Malesia has not been a source area or invasion track of dipterocarps to New Guinea, particularly if the fossil *Shorea* record from Timor is correct.

Finally, there appears to have been a considerable extinction of dipterocarps in the Deccan Peninsula as shown by the range map (Fig. 2); *Anisoptera* and *Dryobalanops* have become extinct there, as has the latter also in Java. Whether *Parashorea* has ever occurred in the Deccan is uncertain, let alone the Bornean endemic genus *Upuna*.

The monotypic genus *Upuna*, endemic in Borneo, deserves special attention. It is primitive in several respects, notably it superficially resembles the primitive genus *Monotes* of a different subfamily while it shares a putative aril with the Ceylonese genus *Stemonoporus* and *Vateriopsis* of the Seychelles. It is most closely allied however to the Malaysian genus *Anisoptera*, and to a lesser extent *Cotylelobium* and *Vatica*, especially in its wood anatomy. The presence, in Borneo, of *Upuna* emphasises that the story of dipterocarp development on its way east is undoubtedly more complicated than the simple panorama given above would imply, but the fossil record is unfortunately meagre.

All these characters correlate much more closely however with the aseasonal humid region of the Mixed Dipterocarp forests and, if we accept the view that they are derived (see f.f.), we must also accept the possibility that the subfamily originated in a seasonal tropical climate.

I firmly conclude from present knowledge of their reproductive biology, and in particular of the fruit dispersal, lack of seed dormancy, ecology of establishment and seedling ecology that the spread of dipterocarps must be overland. This is compatible with the hypothetical reconstruction above: the big Sunda islands, which were one continuous land area for most of the Pleistocene period are richest in dipterocarps, while the Celebes-Moluccan area could only intermittently have provided land bridges to convey the dipterocarps to New Guinea; its archipelagic geomorphology with frequently interrupted, partial land bridges seems to have impeded migration and prevented many genera from completing the course.

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**Silviculture.** The advanced silvicultural systems developed in Malaya are generally applicable in western Malaysian Mixed Dipterocarp forests and are already described exhaustively by WYATT-SMITH (Mal. For. Rec. 23, 1963).

The principal silvicultural characteristics of dipterocarps in regions of Malesia where they are of economic importance are their absence of coppicing when mature, irregular gregarious flowering, poor fruit dispersal, lack of seed dormancy, high moisture requirements combined with a need for little litter and friable soil conditions at germination, the ability of saplings once established to persist for a number of years in the understorey in deep shade but the need for moderate to abundant light to effect rapid growth. Though species of the seasonal tropics have been successfully propagated by rooted cuttings (MOMOSE, 1978), species of the aseasonal zone have only been propagated with difficulty in this way. These and other characteristics vary among species and timber groups. Silvicultural methods have evolved partially in response to increased ecological understanding, partially owing to changes in forest economics and especially in timber values and labour availability and costs. Plantations and other artificial regeneration are presently generally too costly owing to the care required at and following germination and planting, and the necessity for subsequent weeding. Though enrichment planting, *i.e.* the supplementing of natural regeneration by planting in specially opened gaps or lines in naturally regenerating forest, is sometimes desirable owing to frequently patchy distribution of the preferred species it is doubtfully economically justifiable until cheaper and simpler methods of propagation are developed. The object of natural regeneration is to simplify forest composition so that trees are mostly restricted to a few economic species and the crop is of approximately even age. Originally improvement fellings were undertaken in unfelled forest. Later, in Malaya, the canopy was opened up prior to felling to ensure a satisfactory seedling crop at the time of felling; periodic low intensity fellings ensured retention of seed trees; eventually this proved uneconomic. In the meantime the development of improved preservation techniques combined with increasing labour costs to make the heavy hardwood species, which generally require at least 100 years to reach timber size, uneconomic to regenerate, favouring in particular the light red merantis that can be cropped on a cycle as short as 50-70 years.

Young trees larger than saplings are, as might be expected, poorly represented within the canopy in the forests of the Malay Peninsula and northern Borneo, and it is for this reason that the Malayan Uniform System of silviculture, which advocates a single clear felling every 50-70 years followed by regeneration of seedlings already established on the ground, is practised there. The Philippine Selection System, which advocates selective felling of large trees at approximately twice the



Fig. 13. Cutting timber of *Hopea dryobalanoides* Miq. Tawau, Sabah, Kalabakan concession; tree 48 m tall, 80 cm diam. at 1½ m (Photogr. G. H. S. Wood).

frequency of the fellings in the Malayan system, therefore relies on the existence of an adequate stock of young trees to form each successive crop. There is little quantitative published evidence that this always exists, but if it does it demonstrates a fundamental difference in structure and dynamics between Philippine and other Mixed Dipterocarp forests; this, if correct, may well be due to the more open canopy which might be associated with frequent wind damage in the typhoon zone.

Adequate regeneration persists on the ground between fruiting years in the better forests, and this is why the modern Malayan Uniform System relies on a single felling followed by more or less vigorous poisoning of undesirable species to create favourable light conditions for those preferred. The merantis and other light demanders are generally well able to survive beneath the ensuing dense growth of weed trees and woody climbers and eventually overtop them though this is reported not to be the case, or for the young trees to become misshapen as a consequence, on the most fertile soils where climbers are particularly dense, as in parts of E. Borneo. Under drier conditions, as on high ridges and sandy soils, less rigorous poisoning is essential; in Sabah and elsewhere where labour





Fig. 14. Forest ranger AMPON standing near logs of red and yellow *séraya* (*Shorea* spp.), Kalabakan concession, Tawau, Sabah (Photogr. G. H. S. Wood).

shortages exist poisoning is often not undertaken yet the new crop is claimed still to be satisfactory. The system has to be used intelligently and modified according to local circumstances to succeed; it is ideal for the most productive lowland forests but for many others, especially many hill forests, a satisfactory system is still awaited. In the meantime present overexploitation of the Mixed Dipterocarp forests and abandonment of silvicultural operations is bound to lead to a future hardwood shortage at a time when a glut in agricultural export crops is predictable; then drastic price reversals will favour those who have maintained an adequate natural, or more especially silviculturally improved, forest estate.

Uses. *Timber*. Fig. 13–14. Presently the medium or light weight pinkish or reddish hardwoods known as *red mēranti* (Mal.), *red séraya* (Sabah) or *red luan* (Philippines) are the chief export timber in Malesia; they are produced by *Shorea* sect. *Rubella*, *Brachypterae*, *Pachycarpae*, *Ovalis* and *Mutica*. They are used chiefly for light construction, furniture etc., but also for veneers. They are liable to fungal attack in contact with the ground and do not take preservatives easily, though



Fig. 15. Slash and resin drippings of *Hopea sangal* KORTH. Brunei (Photogr. ASHTON).

Fig. 16. Tapping of resin (*damar sibosa*) in trunk of *Shorea javanica* K. & V. New tap-holes filled with white resin in rows between older ones; with forest officer VERHOEF. Sumatra, distr. Baros, Kp. Sioidang (Photogr. J. BURER, 1937).

preserving their shape well on drying owing to their interlocked grain; they vary greatly in density between species, and sometimes within (*S. albida*). A similar timber, *yellow mēranti* from *Shorea* sect. *Richetioides*, is a less attractive tawny yellow and less valuable. The whitish timber of *white luan* or *white sēraya* (lighter *Parashorea* spp., especially *P. malaanonan* in Sabah and the Philippines) is a major veneer wood; so also are the similar but siliceous *white mēranti* or *mēlapi* (Sabah) derived from *Shorea* sect. *Anthoshorea*, and the equally siliceous *mērsawa* (Mal.), *pēnggiran* (Sabah), or *palosapis* (Philippines) derived from *Anisoptera* spp. *Kapur*, from *Dryobalanops*, is a popular pale brown light hardwood. Previously the durable heavy hardwoods were valued, but growth rates are too slow (see silviculture), extraction and milling too costly. *Chēngal* (*Neobalanocarpus*) of Malaya was celebrated for its durability and favoured by the Malays for boat as well as house building. *Balau* or *rēsak* (Mal.), *guijo* (Philip.) or *selangan batu* (Borneo), derived from *Shorea* sect. *Shorea* yield valuable heavy hardwoods for heavy construction and decking. Other such heavy hardwoods are derived from the larger *Vatica* and *Cotylelobium* known as *rēsak* (Mal.) and *narig* (Philip.), some *Hopea* known as *chēngal*, *mengerawan*, *giam* (Mal.), *yakal* (Philip.), and from *Upuna*, called *upun batu* or *penyau* (Mal.).

*Fat*. The fruit of many *Shoreas*, and sometimes also *Dryobalanops*, have been boiled as a vegetable by villagers in many countries. The fruit of *Shorea* sect. *Pachycarpae*, and also *S. seminis*, *S. sumatrana*, *S. palembanica*, *S. scaberrima*, *S. hemsleyana*, *S. macrantha*, *S. singkawang* and sometimes other species are collected and exported. The seed contains up to 70% fat; the fat is similar to cocoa butter but has a higher melting point and is favoured in Europe for manufacturing chocolates and cosmetics, and in the past for soap, candles and tallow. In Borneo the fat was used for cooking, being stored as a stick owing to its high melting point. Soaking the seed in water



increases the fat content as well as killing predators and those treated in this way (Black Pontianaks of trade) are considered the best. The pericarp has a low nutritional value as animal food. The trees are rarely grown in plantation owing to the irregularity of fruiting, but could prove a major commodity if this problem were solved.

*Resin.* Fig. 15-16. The oleoresin of *Dipterocarpus* (*gurjun* oil of India; *kanyin* oil of Burma, *minyak kèruing* of western Malasia), destructively tapped by wounding and firing the bark and sapwood, is still used locally for caulking and varnish, being formerly an export commodity; it dries very slowly. The clear crystalline resins of *Neobalanocarpus* and several *Hopeas* (*damar mata kuching*) were formerly valued for varnish manufacture. The resin of *Shorea* is inferior, though used locally for tallow.

*Camphor.* *Dryobalanops aromatica*, and to a lesser extent *D. lanceolata* and *D. beccarii* yield a crystalline camphor which was being traded by Arabs in the 6th century and was already mentioned by MARCO POLO in 1299. The trade centred on the gregarious *D. aromatica* forest of North and East Sumatra and Johore; it was sought from hollows within the trunks by drilling into the wood and smelling; the trees were felled and chopped up to facilitate extraction. As few trees yielded any quantity the search was conducted with great mystery and a cult developed involving rites of exorcism and a camphor language to confuse malignant spirits. The other two species were tapped simply by drilling and scraping the wounds. Besides being exported the camphor was used for manufacturing perfume, incense and for embalming. *Dryobalanops* camphor is distinguished from others by the presence of d. borneol.

*Other minor uses.* The bark of many species is used locally for building the walls of farm huts, and the leaves of large-leaved dipterocarps provide thatch. Charcoal, prepared from the resin of several species, especially in *Shorea* sect. *Richetioides* was used for blackening teeth when this was fashionable. The bark of some *Vatica* and *Hopea* spp. was once used as 'luru', to prevent frothing during the boiling of *Arenga* syrup for sugar manufacture, and to arrest fermentation of toddy.

*Selected literature: General:* BURKILL, Dict. Pl. (1935) 162, 238, 284, 1187, 1254, 1663, 2222; HEYNE, Nutt Pl. ed. 2 (1927) 1093; MEIJER-DREES, Tectona 32 (1939) 954, 968, 986; MOMOSE, Mal. For. 4 (1978) 219. — *Timber:* DEN BERGER & ENDERT, Meded. Proefst. Boschw. 11 (1925) 98; DESCH, Mal. For. Rec. 14 (1941); PEARSON & BROWN, Commercial Timbers of India (1932); REYES, Techn. Bull. 7, Philip. Dept. Agr. (1938); TAMESIS & AGUILAR, Dept. Agr. Nat. Res. Pop. Bull. 44 (1935). — *Fat:* ANDERSON in Williams *et al.*, S.E. Asian plant genetic resources, Bogor (1975) 217; BAL, Landb. 9 (1933) 211; ROWAAN, Landb. 13 (1937) 314; Indische Mercuur 60, 27 (1937) 416; SMYTHIES, Sarawak Gaz. 84, 1206 (1958) 146. — *Resin:* BUCKLY, Mal. For. Rec. 11 (1932); ENDERT, Tectona 2, 28 (1935) 248; FONTANOZZA, Philip. J. Sc. 54 (1934) 77; PARIJS, Bijdr. Kennis Oost-Indische Damarhars, Leiden (1933); RAPPARD, Tectona 30 (1937) 897; SASAKI, Mal. For. 43 (1980) 290 (seed storage and germination); SCHUITMAKER, Tectona 26 (1933) 229; TAMARI, F.R.I. Research Pamphlet 69 (1976); TANG & TAMARI, Mal. For. 36 (1973) 38.

Notes. 1. The herbarium identification of dipterocarps must remain difficult, mainly for the reason that besides leaves also fruit and flowers are required.

The generic key is largely based on sterile characters and those of fruit; I have added an additional key to field groups which may be useful especially in the field.

Species of the genera *Cotylelobium*, *Dipterocarpus*, *Dryobalanops*, *Parashorea* and *Vatica* are also largely keyed out by means of sterile characters together with fruit. So are the species of the large genus *Hopea*, but in this key there are several leads, mostly for a few species, in which flowers are required.

In the largest genus, *Shorea*, leaf characters alone are only diagnostic at sectional level for *Richetioides*. Though bark and leaf characters together can provide a basis for keying out the vast majority of Malesian species, sections — and hence species — are impossible to key reliably without the valuable sectional characters provided by the former. This is because the combination of ontogenetic and phenotypic variability in leaf characters of these emergent trees, combined with the great number of species, makes it impossible to construct a key on this basis though the experienced taxonomist can still identify most by careful matching with named material, based on his knowledge of the intricate combination of subtle features by which the leaf of each species may be diagnosed at least when mature. In this genus flowers provide invaluable sectional, and in some

sections species characters, but fruit are only of limited value particularly for distinguishing the species with short fruit sepals from the rest.

I do not believe, therefore, that the dichotomous key provides a practical means of identifying sterile material in the larger genera.

In the forest it is a different matter, as SYMINGTON so excellently demonstrated. His, and all subsequent, keys to sterile material include the field characters of bark and wood. Such keys are practicable mainly on a provincial basis; they already exist for West and East Malaysia (SYMINGTON, 1943; MEIJER & WOOD, 1964; ASHTON, 1968); all but a handful of Bornean species are included in the latter two. They are not appropriate to a regional monograph, and this account therefore aims to provide the sound taxonomic base upon which forest botanists can build.

The species of *Anisoptera* and *Shorea* are here therefore mainly keyed out on sterile characters and flowers, though in *Shorea* there are a number of leads, mostly for a few species, for which fruit is required.

It would be an impossible task to frame two keys for each genus, one based on flower, the other on fruit characters: in *Vatica* and *Dipterocarpus*, for instance, keys based on sterile characters and flowers are impossible, while in *Shorea* reliance on either flower or fruit alone would be impossible (unless bark characters were included) though the key based on flowers would approach completeness. A reliable key based entirely on vegetative characters visible in the herbarium seems out of the question.

It is a rather unfortunate situation which we have to accept. Also local keys for the various islands would not bring much solution, since each of the three large Sunda islands harbours so many species.

2. As far as the vernacular names are concerned, I have selected only a limited number, as there is much overlapping.

3. BRANDIS, DYER, SYMINGTON, VAN SLOOTEN, I myself, and some other authors have entered in their works quite a number of unpublished names in the synonymy; they were not rarely taken up from herbarium labels where they were put from provisional identifications. They have here only been taken up if they were also taken up in the Index Kewensis.

4. As to the spelling of sectional and subsectional epithets I have adhered to priority of the original epithet given, which was either in the plural or singular.

#### KEY TO THE GENERA

1. Fruit calyx lobes valvate, not incrassate at base. Chromosome number  $x = 11$ . Tribe DIPTEROCARPEAE.
  2. Base of calyx united into a tube enclosing at least the basal half of the nut.
    3. Connectival appendages stout, tapering, at most  $1\frac{1}{3}$  x length of anthers to long-filiform. Nut free. Innovations not lepidote. Leaf without prominent intramarginal nerve; vernation plicate. Fig. 17–20
      1. **Dipterocarpus**
    3. Connectival appendages slender, at least 2 x length of anthers. Nut adnate to calyx tube. Innovations and leaf beneath densely peltate lepidote. Leaf with prominent looped intramarginal nerve; vernation not plicate. Fig. 27, 30
      2. **Anisoptera**
  2. Base of calyx not as above.
  4. Branching of inflorescence truly cymose. Stamens at least 25. Fruit triangular in section. Fig. 33–34
    3. **Upuna**
  4. Branching of inflorescence racemose or subcymose. Stamens not exceeding 15. Fruit terete on section.
    5. Anthers linear, setose along the lateral margins. Style at least 2 x length of ovary. Leaf with distinct looped intramarginal nerve. Fig. 37, 40
      4. **Cotylelobium**
    5. Anthers broadly oblong to subglobose, glabrous. Style less than 2 x length of ovary. Leaf without looped intramarginal nerve. Fig. 41–42
      5. **Vatica**
  1. Fruit calyx lobes  $\pm$  imbricate and with a distinctly incrassate central swelling at base. Chromosome number  $x = 7$ . Tribe SHOREAE.
    6. Fruit calyx lobes all aliform, subequal, or all sort; fusing into a shallow cup at base. Nervation densely parallel. Fig. 48, 50
      6. **Dryobalanops**
    6. Fruit calyx sepals not as above, unequal if aliform or short and subequal. Nervation not as above.
      7. Fruit sepals aliform, unequal, narrowly imbricate. Nut globose, verrucose, lenticellate. Vernation plicate. Fig. 54, 57
        7. **Parashorea**
      7. Fruit sepals prominently imbricate. Nut ovoid, smooth. Vernation not plicate.



- 8. Stamens 15; anthers linear-lorate, with very short terminal connexional appendages. Fruit sepals short, subequal. Fig. 60, 61 . . . . . 8. **Neobalanocarpus**
- 8. Not as above.
- 9. Fruit calyx with 2 aliform and 3 short sepals; if they are all short and subequal then identifiable only by sectional characters of the flower. Fig. 62–76. . . . . 9. **Hopea**
- 9. Fruit calyx with 3 aliform and 2 short sepals, rarely 5 aliform, unequal; if they are all short and subequal then identifiable only by sectional characters of the flower. Fig. 77–116 . . . . . 10. **Shorea**

FIELD KEY TO PRINCIPAL FIELD GROUPS

- 1. Nerves curving round towards the margin and anastomosing to form a distinct intramarginal nerve.
- 2. Bark surface at first smooth, becoming scaly and distinctly scroll-marked, inner bark homogeneous pale brown. Leaf tertiary nerves indistinct; main nerves slender, hardly raised, petiole not swollen at base of lamina, not geniculate. Leaf undersurface lepidote . . . . . 4. **Cotylelobium**
- 2. Bark surface irregular section fissured, flaking but not scroll-marked; inner bark distinctly tangentially laminated. Leaf tertiary nerves scalariform, well spaced, distinct; main nerves  $\pm$  prominent; petiole swollen at base of lamina, geniculate. Leaf undersurface densely lepidote . . . . . 2. **Anisoptera**
- 1. Not as above.
- 3. Fresh leaves on crushing and cut wood  $\pm$  aromatic; leaf nervation parallel, nerves equal . . . . . 6. **Dryobalanops**
- 3. Fresh leaves on crushing and cut wood smelling resinous, but not aromatic; nervation not as above.
- 4. Bark with large pale warty lenticels more or less densely dotted over the surface, or arranged in groups, more rarely in lines; leaf nerves straight, curving round only near the margin, usually distinctly undulate between each nerve owing to the slight persistence of the plicate folding in bud.
- 5. Bark surface yellowish to orange-brown or rust, rarely pink-brown, more or less smooth or flaky; terminal leaf buds prominent, stipule scars amplexicaul; petiole distinctly swollen at base of leaf; leaf coriaceous, not lepidote . . . . . 1. **Dipterocarpus**
- 5. Bark surface mauve-brown to dark purplish brown or tawny brown; more or less closely shallowly fissured, later flaking in small oblong pieces; petiole not or hardly swollen at base of leaf; terminal buds usually small (excl. *P. macrophylla*); stipule scars short (excl. *P. macrophylla*, *P. malaanonan*); leaf thin, white-lepidote beneath at least in saplings and seedlings, frequently so in mature trees . . . . . 7. **Parashorea**
- 4. Lenticels small, usually inconspicuous; leaf nerves  $\pm$  curved from their bases; leaf not folded, vernation not plicate.
- 6. Base cordate; leathery leaf undersurface with a dense felt of white hairs, with darker, pale brown, nervation; bark surface dark chocolate-brown, closely fissured and flaking; buttress low, rounded . . . . . 3. **Upuna**
- 6. Leaf not cordate at base, or, if cordate, without white tomentose undersurface.
- 7. Buttresses low, rounded; bark surface smooth, pale grey-brown; inner bark homogeneous cream to pale brown; wood close textured, ray ends not glistening on tangential surface; leaf tertiary nerves generally reticulate, not drying black . . . . . 5. **Vatica**
- 7. Bark surface, if smooth, chocolate and grey dappled and with thin buttresses; or, if pale brown, wood not dense, ray ends glistening on tangential surface; leaf tertiary nerves scalariform, or, if reticulate, drying black.
- 8. Leaf nervation dryobalanoid or subdryobalanoid. Fig. 64b-c . . . . . many 9. **Hopea**
- 8. Leaf nervation not as above . . . . . 8. **Neobalanocarpus**, some 9. **Hopea**, 10. **Shorea**  
(For distinction between these and their sections, see other keys.)

1. DIPTEROCARPUS

GAERTN. f. Fruct. 3 (1805) 50; BL. Bijdr. (1825) 223; DC. Prod. 16, 2 (1868) 610; DYER, Fl. Br. Ind. 1 (1874) 294; J. Bot. 12 (1874a) 101, 152, t. 143–145, incl. sect. *Sphaerales*, *Angulati*, *Tuberculati*, *Alati et Plicati* DYER, l.c. 102, 103, 105, 107; VESQUE, C. R. Ac. Sc. Paris 78 (1874) 625; J. Bot. 12 (1874) 149; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 194; HEIM, Rech. Dipt. (1892) 24; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 24; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 250; L. G. DEN BERGER, Hand. Ned. Ind. Natuurwet. Congr. Batavia (1926) 400; SLOOT. Bull.

Jard. Bot. Btzig III, 8 (1927) 263; HEYNE, Nutt. Pl. ed. 2 (1927) 1093; PARKER, Ind. For. Rec. 16, 1 (1931) 1; BURK. Dict. (1935) 838; FOXW. Mal. For. Rec. 10 (1932) 56; Philip. J. Sc. 67 (1938) 245; SYM. Mal. For. Rec. 16 (1943) 153; BROWNE, For. Trees Sarawak & Brunei (1955) 102; SMITINAND, Thai For. Bull. 4 (1958) 1; ASHTON, Gard. Bull. Sing. 20 (1963) 233; BACKER & BAKH. f. Fl. Java 1 (1963) 328; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 230; ASHTON, Man. Dipt. Brunei (1964) 16; *ibid.* Suppl. (1968) 6; Gard. Bull. Sing. 31 (1978) 5; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 24. — *Oleoxyton* ROXB. Trans. Soc. Arts London 23 (1805) 413; WALL. Cat. (1828) n. 953, *nomen*. — *Pterigium* CORREA, Ann. Mus. Paris 8 (1806) 397, *p.p.*, *quoad* *P. costatum* (GAERTN. f.) CORREA; ENDL. Gen. Pl. (1840) 1013 ('*Pterygium*'). — *Mocanera* BLANCO, Fl. Filip. ed. 1 (1837) 446, *p.p.*, *quoad* *M. verniciflua* BLANCO. — *Dualiella* HEIM. Bull. Mens. Soc. Linn. Paris 2 (1892) 1011. — *Heimioma* PIERRE, Fl. For. Coch. 4 (1892) t. 259. — **Fig. 17–26.**

Medium-sized to large trees with thick, rounded, usually small and concave, sometimes tall and straight buttresses. *Crown* usually relatively narrow, even or irregular (not cauliflower-shaped), dome-shaped, frequently rather flat, open, with a few large strongly ascending twisted branches. *Bark surface* pale or dark grey to orange-brown, sometimes pink-brown; appearing smooth, shallowly patchily flaked; or appearing square-section fissured, shaggy, with persistent oblong flakes;  $\pm$  prominently densely warty lenticellate. *Twigs* variable, stout or slender, terete or compressed, glabrous or tomentose; with distinct, usually swollen and pale, amplexicaul stipule scars. *Stipules* large, hastate to lorate, obtuse,  $\pm$  succulent, caducous, characteristically carpeting the forest floor in the growing season. *Leaves* coriaceous, rarely thin, margin usually sinuate towards the apex; nerves prominent beneath, straight, curved only towards the margin, with traces of the plicate vernation remaining persistently between them, giving the lamina a corrugated appearance (*cf. Parashorea*); tertiary nerves scalariform; petiole distinctly geniculate, stout. *Inflorescence* racemose, short, stout, zig-zag, few-flowered, somewhat irregularly sparingly branched; bracts as stipules but smaller, fugaceous. *Flowers* large. Fig. 18. Buds ellipsoid. *Calyx* united round the fruit into a tube, but not fused to it; lobes valvate: 2 long, oblong to spatulate,  $\pm$  distinctly 3-nerved, and 3 short, or all 5 short. *Petals* large, narrowly oblong, strongly contorted, loosely cohering at base on falling, cream with a prominent pink stripe down the centre. *Stamens* 15–40, persisting at first in a ring round the ovary after the petals fall; filaments of variable length, broad, compressed, connate at base, tapering apically, latrorse, with 4 pollen sacs, the inner 2 somewhat shorter than the outer 2; appendage to connective short, stout to long filiform, slender, glabrous. *Ovary* enclosed in the calyx tube, the apex ovoid to conical, shortly tomentose; stylopodium cylindrical to filiform, shortly tomentose, narrowing gradually or abruptly into the glabrous filiform style. *Fruit* large. Fig. 17. *Calyx tube* becoming  $\pm$  distinctly constricted into a distal neck as the nut expands; lobes as in flower, but greatly expanded; *nut* ovoid, tomentose with a short acute apical style remnant. *Germination* hypogeal, the intricately folded subequal cotyledons remaining within the fruit and the plumule freeing itself by elongation of the cotyledonary petioles; seed sometimes albuminous at germination.



Distr. About 69 spp., in Ceylon, India, Burma, Thailand, Indochina, and Yunnan and 53 or 54 species in Malaya, Sumatra, Java, Bali, Sumbawa, Borneo, Philippines and intervening islands. Fossil records from the Tertiary in E. Africa. Fig. 19.

Ecol. Evergreen forests and savanna woodland below 1400 m. Some species become semi-gregarious on river banks or alluvium (*D. apterus*, *D. elongatus*), podsols (*D. borneensis*), ridges (several species) and semi-evergreen forest of seasonal climates (*D. gracilis*, *D. costatus*). Seedlings mostly require high light intensities for survival; the genus is least common in dense valley forests.

Anat. One of the most clearly defined genera in the family; twigs with many resin canals, in 1–2 concentric rings, in the outer margin of the pith; leaf traces 3, arising in the distal ½ of each internode with 12 stipule traces; distal end of petiole with 1–3 semicircles of vascular bundles, each with a resin canal, closed by an adaxial bar of collateral vascular tissue.

Taxon. The genus has since DYER (1874a) habitually been divided into five sections on the basis of the fruit calyx tube; *Sphaerales* (tube round in cross-section); *Tuberculati* (with 5 distal tubercles); *Angulati* (5-angled); *Alati* (5-winged) and *Plicati* (5-winged with the wings proliferated into folds thus obscuring the tube). These characters are not only uncorrelated with others, and thus do not appear to define natural groupings, but are inconsistent even within single species. Thus for example the winged fruit calyx tube of *D. zeylanicus* THW. is frequently angled, even smooth; the tuberculate fruit of *D. costulatus* and *D. kunstleri* are sometimes distally winged; the angled fruit of *D. globosus* is sometimes merely obscurely tuberculate and the narrowly winged fruit of *D. fagineus* is sometimes hardly more than angled, while the wings of that of *D. sublamellatus* are partially folded and place it in an intermediate position between *Alati* and *Plicati*. These sections are not therefore adopted in this account (cf. Gard. Bull. Sing. 20, 1963, 234).

Uses. Light to medium timbers absorbing preservatives readily; used for railway sleepers and heavy construction. The oleoresin is tapped in the semi-evergreen forests of Indochina and Burma, and sometimes elsewhere, for varnishes and tallow, but cutting into the bole and wounding the tissues by burning.

Note. Following Rec. 75A of the Code I have treated the generic name as masculine, and not as feminine as VAN SLOOTEN did.

KEY TO THE SPECIES

(sp. 54. *D. orbicularis* excepted)

- 1. Mature fruit calyx tube spherical, not angled, ribbed, tuberculate or winged. . . . . 1. *D. tempehes*
- 2. Fruit calyx lobes vestigial, subequal . . . . . 1. *D. tempehes*
- 2. Fruit calyx lobes unequal, 2 expanded, aliform. . . . . 2. *D. verrucosus*
- 3. Fruit calyx tube verrucose-lenticellate . . . . . 2. *D. verrucosus*
- 3. Fruit calyx tube smooth. . . . . 3. *D. crinitus*
- 4. Stamens 15 . . . . . 3. *D. crinitus*
- 4. Stamens at least 20. . . . . 4. *D. caudiferus*
- 5. Shorter fruit calyx lobes less than 7 mm long, not recurved or revolute. Stamens 25. . . . . 4. *D. caudiferus*
- 5. Shorter fruit calyx lobes at least 8 mm long, prominently recurved and revolute. Stamens 30. . . . . 6. *D. gracilis*
- 6. Twigs and buds densely ferruginous tomentose. . . . . 5. *D. validus*
- 7. Leaf blade glabrescent . . . . . 5. *D. validus*
- 7. Leaf blade persistently tomentose beneath. . . . . 6. *D. gracilis*
- 8. Leaves 8–15 by 4–10 cm; tomentum short . . . . . 6. *D. gracilis*
- 8. Leaves 17–32 by 8–17 cm; tomentum long, tufted . . . . . 7. *D. baudii*
- 6. Twigs and buds buff or golden tomentose or glabrous. . . . . 8. *D. obtusifolius*
- 9. Leaf undersurface shortly densely persistently buff pubescent. . . . . 8. *D. obtusifolius*
- 9. Leaf undersurface sparsely caducously pubescent or glabrous. . . . . 9. *D. rotundifolius*
- 10. Nerves at most 14 pairs. . . . . 9. *D. rotundifolius*
- 11. Petiole at least 4 cm long. Fruit calyx tube ellipsoid. . . . . 9. *D. rotundifolius*
- 11. Petiole shorter than 4 cm long. Fruit calyx tube globose or turbinate. . . . . 10. *D. chartaceus*
- 12. Leaf bud persistently pubescent outside. . . . . 10. *D. chartaceus*
- 13. Leaf to 19 by 9 cm, ovate. Petiole 2.3–2.8 cm long. Twig persistently densely golden pubescent . . . . . 11. *D. caudatus*
- 13. Leaf to 13 by 5 cm, elliptic caudate. Petiole at most 2.5 cm long. Twig ± glabrescent . . . . . 11. *D. caudatus*
- 12. Leaf bud glabrous outside. . . . . 12. *D. kerrii*
- 14. Inside of stipules densely pubescent. Nerves at most 11 pairs . . . . . 12. *D. kerrii*
- 14. Inside of stipules glabrous. Nerves at least 11 pairs . . . . . 13. *D. hasseltii*
- 10. Nerves at least 16 pairs. . . . . 14. *D. retusus*
- 15. Fruit calyx tube subglobose . . . . . 14. *D. retusus*
- 15. Fruit calyx tube obturbinate. . . . . 15. *D. littoralis*

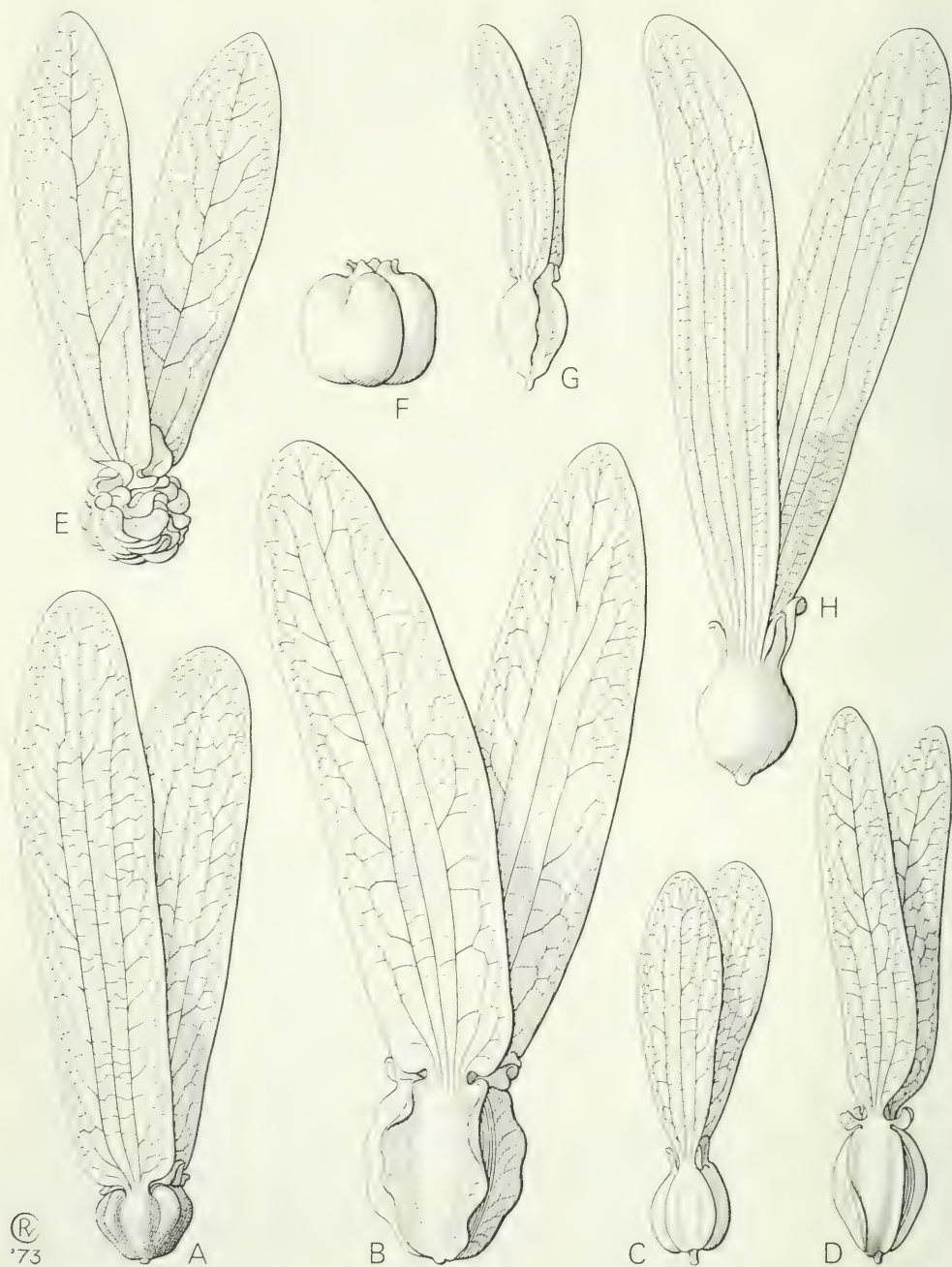


Fig. 17. Fruits in *Dipterocarpus*. All  $\times \frac{1}{2}$ . — A. *D. cornutus* DYER. — B. *D. grandiflorus* (BLCO) BLCO. — C. *D. acutangulus* VESQUE. — D. *D. kunstleri* KING. — E. *D. pachyphyllus* MEIJER. — F. *D. elongatus* KORTH. — G. *D. mundus* SLOOT. — H. *D. retusus* BL. (A KEP 77290, B anon. L sheet 955-159-403, C BNB 4890, D A 3705, E MUJIN 39208, F S 15131, G S 19046, H KOSTERMANS 18730).



- 1. Mature fruit calyx tube angled, ribbed, tuberculate or winged.
  - 16. Fruit calyx tube narrowly elliptic-obovoid, with prominent, sharp or narrowly rounded ribs or wings typically confined to the distal half and  $\pm$  terminating in tubercles. Leaf bud slender, falcate, densely minutely greyish stellate puberulent . . . . . 16. *D. kunstleri*
  - 16. Not as above.
  - 17. Fruit calyx tube spherical, but with 5  $\pm$  prominent apical protuberances below the neck.
    - 18. Fruit calyx tube ovoid . . . . . 17. *D. applanatus*
    - 18. Fruit calyx not ovoid.
      - 19. Leaves with 11–16 pairs of nerves.
        - 20. Leaf beneath pale ochraceous pubescent . . . . . 18. *D. rigidus*
        - 20. Leaf beneath glabrous.
          - 21. Stipules pruinose outside, otherwise glabrous. . . . . 19. *D. costulatus*
          - 21. Stipules tomentose outside . . . . . 20. *D. globosus*
      - 19. Leaves with more than 18 pairs of nerves.
        - 22. Fruit calyx with 2 lobes aliform, more than twice as long as tube.
          - 23. Leaf beneath glabrescent . . . . . 21. *D. humeratus*
          - 23. Leaf beneath densely cream lepidote . . . . . 22. *D. cornutus*
        - 22. Fruit calyx lobes subequal, vestigial . . . . . 23. *D. elongatus*
  - 17. Fruit calyx tube  $\pm$  persistently angled, ribbed or winged.
    - 24. Fruit calyx tube with 5 wings continuing from base to apex, greatly proliferated and intricately folded, obscuring the tube itself.
      - 25. Leaf nervation beneath persistently yellow-brown hirsute. Twigs terete . . . . . 24. *D. lamellatus*
      - 25. Leaf nervation beneath glabrous. Twigs compressed.
        - 26. Leaves ovate-lanceolate, margin revolute. Nerves 15–20 pairs. Petiole stout, tomentose . . . . . 25. *D. lowii*
        - 26. Leaves broadly ovate, margin not revolute. Nerves 10–12 pairs. Petiole slender, glabrous . . . . . 26. *D. pachyphyllus*
    - 24. Fruit calyx tube with 5 angles, ribs or wings, straight or undulate but not intricately folded.
    - 27. Fruit calyx tube at least  $1\frac{1}{2}$  times as long as broad, distinctly ellipsoid.
      - 28. Calyx tube angled rather than winged.
        - 29. Leaves large, at least 15 cm long.
          - 30. Leaves suborbicular. Nerves 9–12 pairs . . . . . 27. *D. confertus*
          - 30. Leaves ovate or elliptic. Nerves 24–30 pairs . . . . . 28. *D. dyeri*
        - 29. Leaves small, not exceeding 4 cm long.
          - 31. Stamens 15. Leaf undersurface glabrescent . . . . . 29. *D. fagineus*
          - 31. Stamens 23–25. Leaf undersurface puberulent . . . . . 30. *D. cinereus*
    - 28. Calyx tube distinctly winged.
      - 32. Fruit calyx tube densely pale buff puberulent, with very narrow undulate wings.
        - 33. Nerves 6–8 pairs . . . . . 31. *D. semivestitus*
        - 33. Nerves 16–20 pairs . . . . . 32. *D. oblongifolius*
      - 32. Fruit calyx glabrous, wings if narrow straight.
        - 34. Wings of calyx tube at least 8 mm wide, prominent.
          - 35. Stamens 30 . . . . . 33. *D. grandiflorus*
          - 35. Stamens 15.
            - 36. Young twig, petiole and bud glabrous . . . . . 34. *D. glabrigemmatus*
            - 36. Young twig, petiole and bud pubescent . . . . . 35. *D. palembanicus*
        - 34. Wings of calyx tube at most 6 mm wide, narrow
          - 37. Calyx tube wings most prominent in the distal half.
            - 38. Calyx tube wings continuous from base to apex.
              - 39. Leaf bud buff velutinate. Leaf undersurface sparsely so. Flower unknown . . . . . 36. *D. fusiformis*
              - 39. Leaf bud and leaf glabrous. Stamens 15 . . . . . 37. *D. mundus*
            - 38. Calyx tube wings  $\pm$  absent in basal  $\frac{1}{2}$  of tube. Stamens 25. Leaf undersurface and bud pubescent . . . . . 38. *D. borneensis*
          - 37. Calyx tube wings not as above. Stamens 15 . . . . . 39. *D. nudus*
    - 27. Fruit calyx tube less than  $1\frac{1}{2}$  times as long as broad, broadly ellipsoid to globose (sometimes with the wings decurrent with the pedicel and thus appearing narrowly ellipsoid).
    - 40. Fruit calyx tube persistently pubescent.
      - 41. Leaf and petiole glabrous . . . . . 40. *D. geniculatus*
      - 41. Leaves undersurface and petiole persistently tomentose.
        - 42. Nerves at most 14 pairs . . . . . 41. *D. costatus*
        - 42. Nerves at least 15 pairs . . . . . 42. *D. conformis*

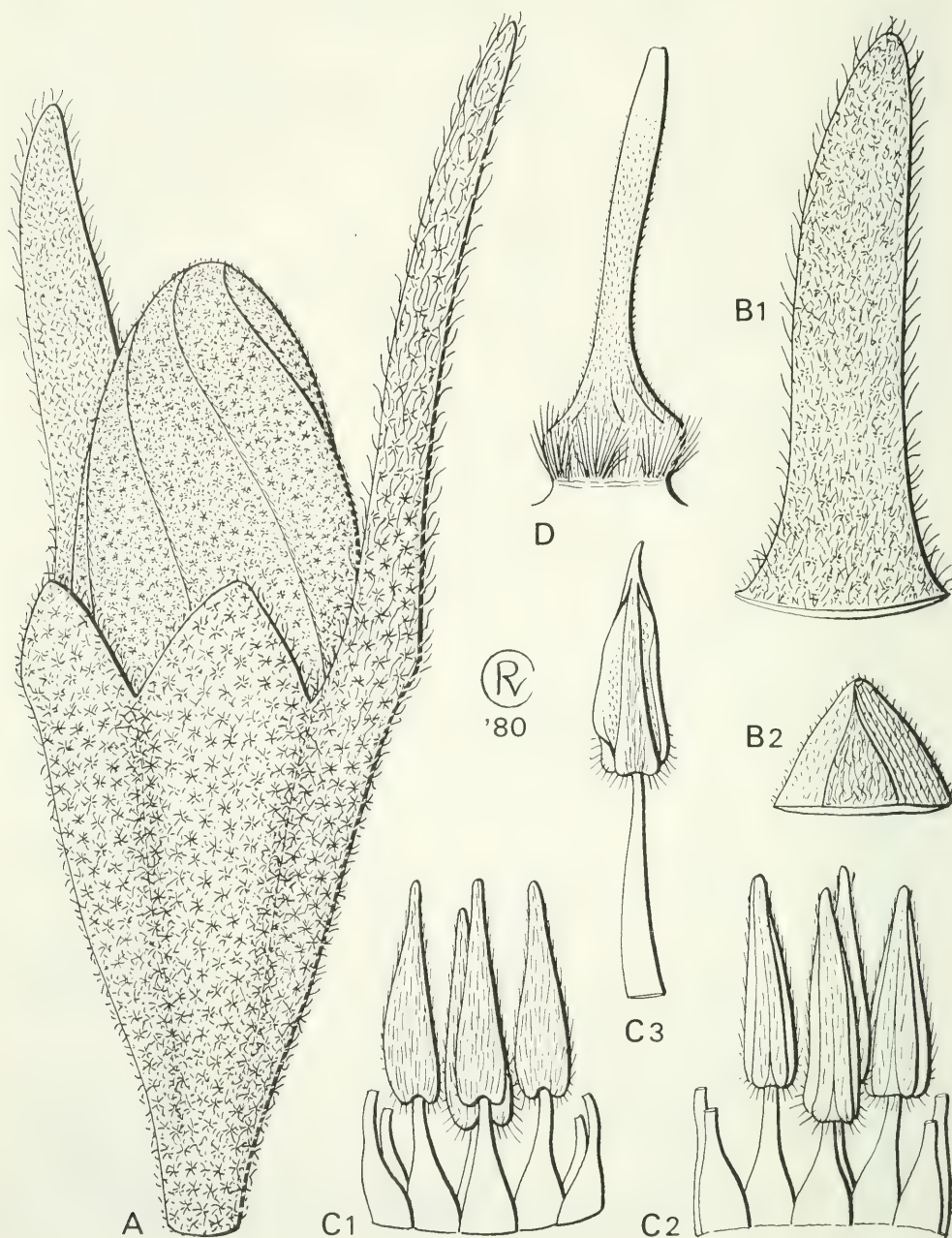


Fig. 18. Flower details in *Dipterocarpus*. All  $\times 5$ . — *D. verrucosus* Foxw. ex SLOOT. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C1. stamens from outside, C2. stamens from inside, C3. older stamen, D. pistil (JACOBS 5461).



40. Fruit calyx tube glabrescent.  
 43. Fruit calyx tube angled rather than winged . . . . . 43. *D. acutangulus*  
 43. Fruit calyx tube distinctly winged.  
 44. Wings of calyx tube exceeding 10 mm wide.  
 45. Leaves glabrous. Wings of calyx tube not decurrent with pedicel . . . . . 44. *D. sublamellatus*  
 45. Leaves densely tomentose beneath. Wings of calyx tube decurrent with pedicel.  
 46. Leaves prominently cupped . . . . . 45. *D. concavus*  
 46. Leaves applanate . . . . . 46. *D. stellatus*  
 44. Wings of calyx tube at most 9 mm wide.  
 47. Leaves obtuse, broadly obovate, obtuse or retuse . . . . . 47. *D. sarawakensis*  
 47. Leaves not as above.  
 48. Wings of fruit calyx tube not continuous to base. Leaves large . . . . . 48. *D. coriaceus*  
 48. Wings of fruit calyx tube continuous to base. Leaves medium-sized.  
 49. Wings of fruit calyx tube broadest distally, to 9 mm broad. Leaves prominently cuspidate  
 49. *D. cuspidatus*  
 49. Wings of fruit calyx tube not broadest distally. Leaves not cuspidate in mature trees.  
 50. Wings of calyx tube less than 3 mm wide, very narrow.  
 51. Leaves at most 10 by 4.5 cm . . . . . 50. *D. eurynchus*  
 51. Leaves 10–19 by 4.5–9.5 cm . . . . . 51. *D. ochraceus*  
 50. Wings of calyx tube to 8 mm wide, prominent.  
 52. Parts glabrous but for ovary . . . . . 52. *D. perakensis*  
 52. Buds, twigs, petioles and nervation beneath densely persistent ochraceous pubescent  
 53. *D. philippinensis*

1. *Dipterocarpus tempehes* SLOOT. Reinwardtia 5 (1961) 468, f. 4; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 270, f. 43B; ASHTON, Man. Dipt. Brun. Suppl. (1968) 18, f. 3.

Twigs, leaf bud, stipule outside, and petiole very shortly densely evenly buff pubescent, leaf nervation beneath and stipule within sparsely so; nervation above caducously so. *Twigs* to 2 by 4 mm  $\varnothing$  towards the compressed apices, much branched, slender, becoming terete; stipule scars slender, dark. *Bud* to 12 by 3 mm, slender, lanceolate, acute. *Stipule* to 8 by 1.2 cm, lorate, acute. *Leaves* 6–12 by 3.5–8 cm, broadly elliptic to obovate, thickly coriaceous, with broadly cuneate base and acute to shortly abruptly acuminate apex; prominently persistently folded between the

9–12 pairs of sharply ascending nerves; nerves at 35°–40°; tertiary nerves very slender, densely scalariform; *petiole* 1–2 cm long, short, drying densely buff pubescent. *Raceme* to 2.5 cm long, very short, axillary, terete, densely shortly evenly buff pubescent, unbranched, bearing to 3 distichous flowers. *Flower bud* to 3 by 0.8 mm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* c. 30, somewhat shorter than anther; anther narrowly oblong, tapering into the acicular appendage; appendage as long as anther, prominent. *Ovary* ovoid, pubescent; style filiform, pubescent except in the apical 1/3. *Fruit pedicel* vestigial. *Calyx* glabrous; tube to 4 by 4 cm, turbinate, with prominent but unraised pale lenticels; calyx lobes vestigial.

Distr. *Malesia*: Borneo (Kapuas valley, Sarawak west of the Niah R., E. Sabah south to Kutei).

Ecol. Locally abundant, fresh water swamps and stream banks, clay rich alluvium.

Vern. *Kéruing tépayan*, *k. asam*, *karup*, *bajan*, *bajan uhit*, *tempèhès*.

2. *Dipterocarpus verrucosus* FOXW. ex SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 293; SLOOT. in Merr. Pl. Elm. Born. (1929) 201; FOXW. Mal. For. Rec. 10 (1932) 71; SYM. Mal. For. Rec. 16 (1943) 189, f. 84B, 85; BROWNE, For. Trees Sarawak & Brunei (1955) 111; ASHTON, Man. Dipt. Brun. (1964) 46, f. 6–7, pl. 6 (stem); *ibid.* Suppl. (1968) 19; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 272, f. 3C, 43A. — Fig. 18, 20.

Twig, petiole, midrib and nerves beneath densely caducous minute adpressed tufted gold-brown pubescent; leaf bud and raceme densely, stipules sparsely, persistently so. *Twig* 1.5–3 mm  $\varnothing$  apically, terete or slightly compressed; amplexicaul scars slightly swollen. *Bud* to 12 by 2–3 mm, acute, narrowly falcate to narrowly conical. *Stipule* to 8 by 0.8 cm, narrowly

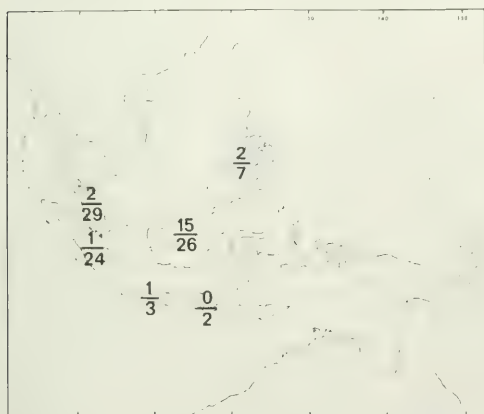


Fig. 19. Density map of *Dipterocarpus* in *Malesia*. Above the hyphen the number of endemics, below the hyphen the number of non-endemics.

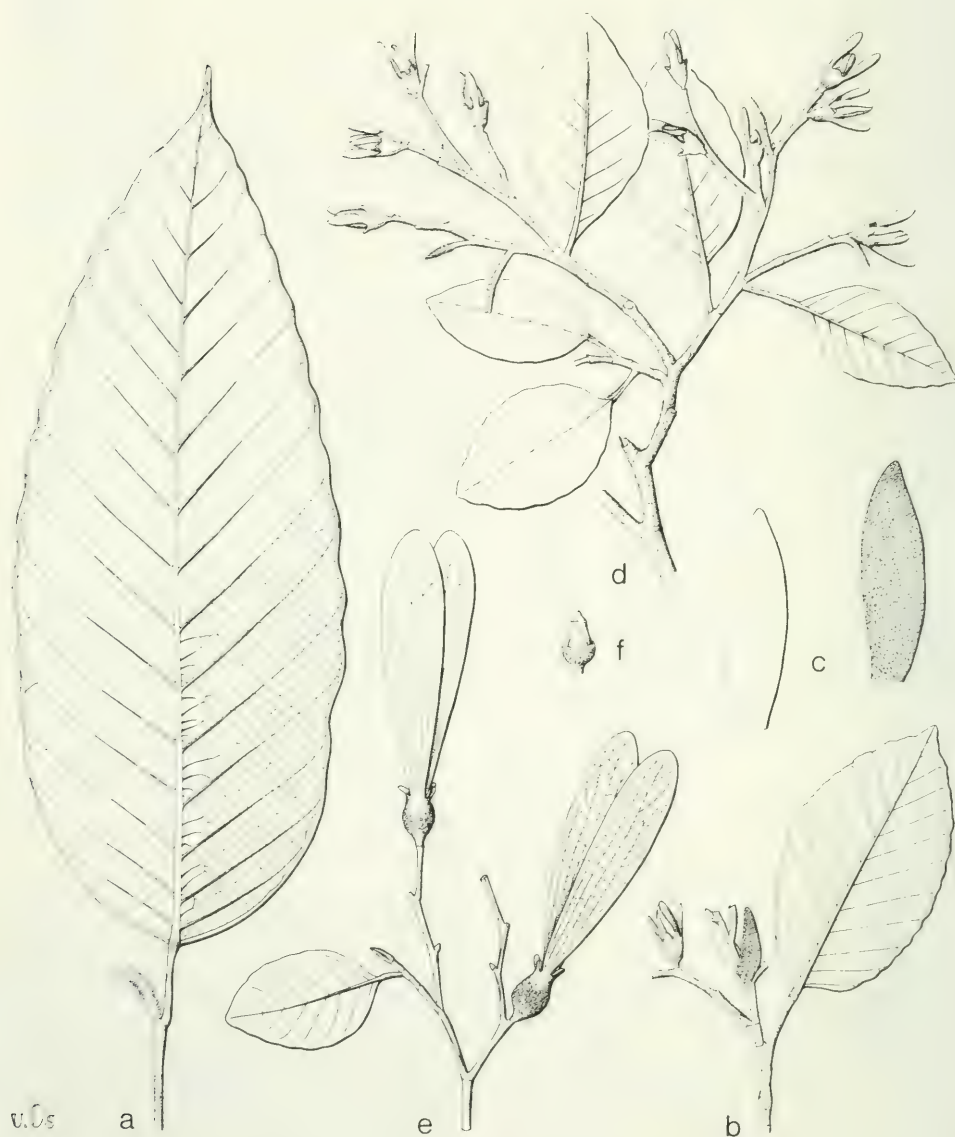


Fig. 20. *Dipterocarpus verrucosus* SLOOT. a. Terminal bud and leaf of 7½ m high sapling, b. young inflorescence with stipules, c. stipules outside hairy, inside glabrous, d. older inflorescence without stipules, e. fruits, f. nut. All  $\times \frac{1}{2}$  (a S 20286, b-c KEP 105026, d KEP 105157, e-f NT 429).



oblong, obtuse. *Leaves* 6–12 by 3.5–6 cm, ovate, coriaceous; base cuneate; apex subacute or with to 5 mm long acumens; nerves 9–14 pairs, prominent, well spaced, at  $c. 40^{\circ}$ – $50^{\circ}$ ; tertiary nerves well spaced,  $\pm$  sinuate; *petiole* 1.2–2 cm long, geniculate. *Raceme* to 9 cm long, axillary, unbranched or singly branched, terete. Flower buds to 25 by 12 mm, fusiform. *Calyx* shortly densely pubescent; *corolla* typical. *Stamens* 15, exceeding style apex in bud; filaments as long as anthers, narrowly deltoid, applanate; anthers narrowly oblong, pubescent, tapering into the short broad obtuse connective appendage. *Ovary* conical, tapering, pubescent; style glabrescent, as long as ovary, swollen below apex. *Fruit calyx tube* to 1.5 by 1.3 cm, globose to slightly ovoid, with 5–7 mm  $\varnothing$  neck, glabrescent, dotted with verrucose pale brown lentils; 2 longer lobes to 9 by 2.2 cm, oblong to spatulate, obtuse,  $c. 3$  mm broad at the non-revolute base, 3-nerved, the 2 laterals continuing at least  $\frac{3}{4}$  of the length; 3 shorter lobes to 3 by 2 mm, narrow, revolute and recurved.

Distr. *Malesia*: Malaya (excepting more seasonal areas), Sumatra (Asahan and Indragiri in east, Kampar-Siak on west coast), Singkep, Borneo (West Borneo and Sarawak to S. W. Sabah, Tawau, Nunukan).

Ecol. Mixed Dipterocarp forest on clay rich soil, occasional on undulating land but locally common on ridges below 650 m.

Vern. *Këruing mërak, k. chàiër* (Mal.), *k. ladan, k. daun halus, ariung* (Sum.).

**3. *Dipterocarpus crinitus* DYER**, Fl. Br. Ind. 1 (Jan. 1874) 296; VESQUE, C. R. Ac. Sc. Paris 78 (March 1874) 627; DYER, J. Bot. 12 (April 1874) 103, 154; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 90; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 28; RIDL, Agr. Bull. Str. & F.M.S. 1 (1901) 55; Fl. Mal. Pen. 1 (1922) 214; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 273; ed. 2 (1927) 1095; BURK, J. Str. Br. R. As. Soc. 81 (1920) 58, fig.; Dict. (1935) 843; MERR. En. Born. (1921) 398; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 288; Foxw. Mal. For. Rec. 10 (1932) 66; SYM. Mal. For. Rec. 16 (1943) 175, f. 84A, 85, 89; BROWNE, For. Trees Sarawak & Brunei (1955) 108; ASHTON, Man. Dipt. Brun. (1964) 29, f. 6; *ibid.* Suppl. (1968) 13; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 246. — *D. hirtus* VESQUE, C. R. Ac. Sc. Paris 78 (March 1874) 627; J. Bot. 12 (1874) 151; DYER, J. Bot. 12 (1874) 154. — *D. tampurau* (non KORTH.) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 198, p.p.; BROWNE, For. Trees Sarawak & Brunei (1955) 108. — **Fig. 21.**

Young twig, leaf bud, stipule outside and petiole persistently  $c. 3$  mm long golden-brown tufted tomentose, shorter on nervation beneath, midrib above and margin; leaf fugaceous pubescent above. *Twig c.* 3 mm  $\varnothing$  apically, smooth. *Bud* 4–6 by 1.5–2 mm, small, oblong, obtuse. *Stipule c.* 3 by 0.5 cm, lanceolate, obtuse. *Leaves* 6–9 by 3–5 cm, elliptic, chartaceous, obtuse or shortly acuminate, base obtuse, margin revolute, persistently somewhat folded between the

13–15 pairs of nerves; *petiole* 1.5–2.5 cm long, slender. *Raceme* to 12 cm long, terminal or axillary, terete, golden long tomentose, unbranched or singly branched, branchlets bearing  $c. 4$  flowers; *bracts* to 30 by 8 mm, linear, acute, sparsely tomentose outside, glabrous within. *Flower bud* to 3.5 by 0.8 cm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* 15, shorter than the style; filaments short, anthers filiform, tapering; appendage as long as anther, slender, undulated towards the apex. *Ovary* ovoid-conical, shortly pubescent; style and stylopodium filiform, slender, 4–5 times as long as ovary, shortly pubescent but for the distal  $\frac{1}{3}$ . *Fruit* sessile. *Fruit calyx* glabrous, tube 1.5–1.8 by 0.6–0.8 cm, neck 0.4–0.6 cm  $\varnothing$ ; two longer lobes to 8 by 1.5 cm, oblong, lanceolate, acute, prominently 1-nerved; 2 shorter lobes to 3 mm long, deltoid, acute.

Distr. E. Peninsular Thailand, and in *Malesia*: Malaya (excluding seasonal areas), Sumatra (Asahan, Indragiri, Bengkalis districts; Central Sumatra: Sibolga, W. Indragiri), Borneo.

Ecol. Widespread on undulating land and low hills, rarely to 850 m, on leached clay-rich soils in Mixed Dipterocarp forest.

Vern. *Këruing (m) empêlas, tampurau, k. bulu, k. gombang, k. pêkat, k. mërakluang, k. chaier* (Mal.), *ariung, simarhalung* (Sum.), *rësak empêlas* (Iban).

Note. Individuals, often in considerable numbers, of this species are well known in Malaya to flower and fruit outside general flowering years; the same occurs in Borneo. Though seedlings are usually common in the forest, as a rule very few seeds are viable.

**4. *Dipterocarpus caudiferus* MERR.** Philip. J. Sc. 29 (1926) 398; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 302; BROWNE, For. Trees Sarawak & Brunei (1955) 107; SLOOT, Reinwardtia 5 (1961) 459; ASHTON, Gard. Bull. Sing. 20 (1963) 236; Man. Dipt. Brun. (1964) 25, f. 6; *ibid.* Suppl. (1968) 11; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 239, pl. 20 (habit), pl. 24, f. 35. — *D. macrorrhinus* SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 300, f. 3. — *D. kutaianus* SLOOT, Bull. Jard. Bot. Btzig III, 16 (1940) 437, f. 2; BROWNE, For. Trees Sarawak & Brunei (1955) 110.

Twig, leaf beneath and margin, petiole, raceme and young leaf bud sparsely, 2–2.5 mm long,  $\pm$  fugaceous or caducous silky long tomentose; subsistent on young trees, occasionally persistent on bud, twig, and petiole. *Twig c.* 5 mm  $\varnothing$ , rather stout, terete; frequently rather verrucose and sometimes (usually in young trees) papery. *Bud* 10–25 by 3–5 mm, lanceolate, somewhat compressed. *Stipules c.* 7 cm long, linear. *Leaves* 11–20 by 5–15 cm, elliptic, thinly coriaceous, base obtuse or cuneate, apex prominently to 8 mm long acuminate; margin frequently sinuate towards the apex; midrib beneath often slightly verrucose; nerves 12–20 pairs, dense, straight, at  $c. 40^{\circ}$ – $50^{\circ}$ ; tertiary nerves densely scalariform, slender; *petiole* 3–4 cm long, rather long and slender, persistently hispid on the knee. *Raceme* to 15 cm long, terminal or axillary, terete, becoming angular on



Fig. 21. Habit of *Dipterocarpus crinitus* DYER, *kěruing ampēlas*. Brunei (Photogr. ASHTON).



drying, simple or singly branched; *bracteoles* to 30 by 2.5 mm, linear, glabrous, caducous. *Flowers* distichous; *buds* to 5 by 0.8 cm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* 25, shorter than the style; filaments short; anthers narrowly oblong, tapering apically; appendage to connective tapering, glabrous, slightly shorter than the anther. *Ovary* ovoid-conical, glabrescent; stylopodium twice as long as ovary, narrowly cylindrical, densely tomentose; style half as long as stylopodium, narrowly cylindrical, glabrous. *Fruit calyx* entirely glabrous; tube to 3.5 cm  $\varnothing$  and long, obturbinate, tapering abruptly at the base and gradually to the 0.8–1.3 cm  $\varnothing$  neck; 3 longer lobes 12–17 by 2–3 cm, oblong-lanceolate, obtuse, tapering to c. 5 mm broad at the base, prominently 3-nerved; shorter lobes 4–6 by 5–7 mm, deltoid, obtuse, undulate.

Distr. *Malesia*: Borneo (except S. and S.W.), Banguay I.

Ecol. Clay soils in Mixed Dipterocarp forests, on undulating land and hillsides below 800 m; sometimes semigregarious on fertile soils.

Vern. *Andri*, *damar laut*, *sëndara* (W. Borneo), *bajan*, *santiulit*, *têmpehès* (S.E. Borneo), *këruing puteh*.

Note. Geographically rather variable, especially in S.E. Borneo where the closely related *D. hasseltii* also occurs and can be difficult to distinguish from it when not in fruit.

**5. *Dipterocarpus validus* BL.** Mus. Bot. Lugd.-Bat. 2 (1852) 36; WALP. Ann. 4 (1857) 335; MIQ. Fl. Ind. Bat. 1, 2 (1859) 498; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 84, 85; DC. Prod. 16, 2 (1868) 614; DYER, J. Bot. 12 (1874) 108, 153; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 202; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37; MERR. En. Born. 1921 400; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 272; ASHTON, Gard. Bull. Sing. 20 (1963) 237. — *D. pilosus* (non ROXB.) F.-Vill. Nov. App. (1880) 20; VIDAL, Synopsis (1883) pl. 14, f. d; FOXW. Philip. J. Sc. 6 (1911) Bot. 244, pl. 34; *ibid.* 13 (1918) Bot. 176; MERR. En. Philip. 3 (1923) 88. — *D. warburgii* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 32; FOXW. in Merrill, Leaf. Philip. Bot. 6 (1913) 1952; Philip. J. Sc. 13 (1918) Bot. 178; MERR. En. Philip. 3 (1923) 91; HEYNE, Nutt. Pl. ed. 2 (1927) 1098; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 305; FOXW. Philip. J. Sc. 67 (1938) 256; SLOOT, Reinwardtia 5 (1961) 473; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 273. — *D. affinis* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 31; WHITFORD, Bull. Bur. For. Philip. 10, 2 (1911) 70, pl. 72–73; FOXW. Philip. J. Sc. 6 (1911) Bot. 246, pl. 35; *ibid.* 13 (1918) Bot. 176; MERR. En. Philip. 3 (1923) 88. — *D. lasiopodus* PERK. Fragm. Fl. Philip. (1904) 22; MERR. Publ. Gov. Lab. Philip. 29 (1905) 30; En. Philip 3 (1923) 90; REYES, Philip. J. Sc. 22 (1923) 322, pl. 13. — *D. woodii* MERR. Philip. J. Sc. 29 (1926) 399; SLOOT, Bull. Jard. Bot. Btzig 8, III (1927) 303. — **Fig. 22.**

Large pale barked frequently buttressed trees. Twigs, leaf buds, stipules outside, petioles and base of inflorescence densely  $\pm$  persistently evenly long rufous

tomentose, becoming distinctly tufted as the twigs and stipules expand; nerves and midrib beneath and inflorescence sparsely evenly puberulent. *Twigs* c. 6–10 mm  $\varnothing$ , terete. *Leaf buds* to 9 by 1.3 cm, lanceolate; *stipules* to 20 by 3 cm, lorate. *Leaves* 15–25 by 7.5–12 cm (to 40 by 20 cm in young trees), elliptic-oblong to ovate, coriaceous; margin undulate, prominently sinuate distally; base cuneate to obtuse (narrowly peltate in young trees); apex acute to prominently narrowly acuminate, to 1 cm long; nerves 22–28 pairs, straight, ascending at c. 50°, slender but prominent beneath,  $\pm$  shallowly depressed above; tertiary nerves densely scalariform, very slender, evident but hardly elevated beneath; midrib prominent beneath,  $\pm$  elevated above; *petiole* 3.5–5 cm long, prominently geniculate. *Raceme* to 14 cm long,  $\pm$  unbranched, axillary, bearing to 7 flowers. *Flower buds* to 30 by 9 mm; *stamens* c. 30, slightly shorter than style at anthesis; filaments slender, c.  $\frac{1}{2}$  length of filiform auriculate tapering anthers; appendage acicular, slender, c.  $\frac{3}{4}$  length of anthers; *ovary* small, ovoid, hirsute as also the basal  $\frac{1}{2}$  of style; style stoutly columnar, c. 4 times length of ovary. *Fruit pedicel* expanding into the to 4 by 3.5 cm smooth turbinate calyx tube; 2 longer lobes to 25 by 3.5 cm, lorate-spatulate, obtuse, c. 5 mm broad at base; 3 shorter lobes to 6 by 6 mm, suborbicular, small,  $\pm$  recurved.

Distr. *Malesia*: Philippines (widespread), Borneo (Tenom in north, and E. Coast of Sabah south-eastwards to river Barito).

Ecol. Common and frequently gregarious both in primary and secondary forest; on flat land, fresh water swamp and on river banks; occasionally on low hills to 300 m.

Vern. *Hagakhak* (Philippines), *këruing kasugoi* (Sabah), *kambong*, *tampudau*, *kaladan* (S.E. Borneo).

Note. There is some evidence of hybridisation with *D. kunstleri* in the Philippines.

**6. *Dipterocarpus gracilis* BL.** Bijdr. (1825) 224; Fl. Jav. 2 (1829) 20, t. 5; WALP. Rep. 5 (1845) 123; MIQ. Fl. Ind. Bat. 1, 2 (1859) 497; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; DYER, J. Bot. 12 (1874) 102; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 196; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 256; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 30; K. & V. Bijdr. 5 (1900) 117; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 358; FOXW. Philip. J. Sc. 6 (1911) Bot. 248; *ibid.* 13 (1918) Bot. 177; *ibid.* 67 (1938) 249; KOORD. Exk. Fl. Java 2 (1912) 621; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 273; *ibid.* ed. 2 (1927) 1094, 1095; MERR. En. Philip. 3 (1923) 89; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 251; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 276; *ibid.* III, 16 (1940) 434; SYM. Gard. Bull. S. S. 9 (1938) 321; Mal. For. Rec. 16 (1943) 177, f. 85; SMITINAND, Thai For. Bull. 1 (1954) 5; *ibid.* 4 (1958) 31; BACKER & BAKH. f. Fl. Java 1 (1963) 329; ASHTON, Gard. Bull. Sing. 20 (1963) 235; Man. Dipt. Brun. (1964) 35, f. 6; *ibid.* Suppl. (1968) 15; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 250, f. 37. — *D. pilosus* ROXB. [Hort. Beng. (1814) 93, *nomen*]



Fig. 22. Close-up of bark, leaves and fruit of *Dipterocarpus validus* BL. Sabah (Photogr. G.H.S. WOOD).

Fl. Ind. ed. Carey 2 (1832) 615; WALP. Rep. 5 (1845) 124; DC. Prod. 16, 2 (1868) 614; DYER, Fl. Br. Ind. 1 (1874) 296; KURZ, Fl. Burma (1877) 115; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 244; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 27, *p.p.*; Ind. Trees (1906) 65; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 274, *p.p.*; TROUP, Silv. Ind. Trees 1 (1921) 39; GAMBLE, Man. Ind. Timb. (1922) 71; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 251, *p.p.*; PARKER, Ind. For. Rec. (Bot.) 13 (1927) 15; PARKINSON, Burma For. Bull. 27 (1922) 25. — *Mocanera verniciflua* BLCO, Fl. Filip. ed. 1 (1837) 450. — *D. marginatus* KORTH. Kruidk. (1841) 64; WALP. Rep. 5 (1845) 124; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 37; MIQ. Fl. Ind. Bat. 1, 2 (1859) 499; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 613; DYER, J. Bot. 12 (1874) 105; BURCK,

Ann. Jard. Bot. Btzg 6 (1887) 212; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 38; MERR. En. Born. (1921) 399; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 328, f. 10, *p.p.*; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 274; *ibid.* ed. 2 (1927) 1097. — *D. vernicifluus* BLCO, Fl. Filip. ed. 2 (1845) 314; *ibid.* ed. 3 (1878) 217, t. 183; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 35; WALP. Ann. 4 (1857) 335; MIQ. Fl. Ind. Bat. 1, 2 (1858) 499; DC. Prod. 16, 2 (1868) 610; VIDAL, Sinopsis (1883) 15, t. 14 b; Rev. Pl. Vasc. Filip. (1886) 59; DYER, J. Bot. 12 (1874) 104; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 31; MERR. Philip. J. Sc. 1 (1906) Suppl. 97; *ibid.* 3 (1908) Bot. 114; Sp. Blanc. (1918) 268; En. Philip (1923) 91; Foxw. Philip. J. Sc. 6 (1911) Bot. 248; *ibid.* 13 (1918) Bot. 177; REYES, Philip J. Sc. 22 (1923) 321; HEYNE, Nutt. Pl. ed. 2 (1927) 1095. — *D. fulvus* BL. Mus. Bot. Lugd.-Bat.



2 (1852) 37; WALP. Ann. 4 (1857) 335; MIQ. Fl. Ind. Bat. 1, 2 (1859) 499; DC. Prod. 16, 2 (1868) 613; DYER, J. Bot. 12 (1874) 108; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40. — *Anisoptera palembanica* MIQ. Sum. (1862) 191, 485; Ann. Mus. Bot. Lugd.-Bat. (1867) 85; DC. Prod. 16, 2 (1868) 616. — *D. hispidus* (non THW.) F.-VILL. Nov. App. (1880) 20. — *D. velutina* VIDAL, Rev. Pl. Vasc. Filip. (1886) 59; PERK. Fragm. Fl. Philip. (1904) 22; MERR. Philip. J. Sc. 3 (1908) Bot. 114. — *D. bancanus* BURCK, Ann. Jard. Bot. Btzg 6 (1887) 196; BRANDIS J. Linn. Soc. Bot. 31 (1895) 31; HEYNE, Nutt. Pl. ed. 2 (1927) 1095. — *D. skinneri* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 91; BRANDIS, J. Linn. Soc. Bot. 3 (1895) 26; RIDL. Fl. Mal. Pen. 1 (1922) 214; CRAIB, Fl. Siam. Enum. 1 (1925) 137; HEYNE, Nutt. Pl. ed. 2 (1927) 1098; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 294; FOXW. Mal. For. Rec. 10 (1932) 70, excl. var. *hirtus* RIDL.; BURK. Dict. (1935) 845. — *D. vanderhoevenii* K. & V. Bull. Inst. Bot. Btzg 2 (1899) 3; Bijdr. 5 (1900) 118; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 356; KOORD. Exk. Fl. Java 2 (1912) 621. — *Shorea mollis* BOERL. Cat. Hort. Bog. 2 (1901) 110. — *D. angustialatus* HEIM, Bot. Tidsskr. 25 (1903) 43; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 365; CRAIB, Fl. Siam. Enum. 1 (1925) 133; FISCHER, Kew Bull. (1926) 457. — *D. schmidtii* HEIM, Bot. Tidsskr. 25 (1903) 43.

Twig, leaf bud, stipule outside, leaf beneath, midrib above and petiole densely persistently scabrid rufous tomentose. *Twig* c. 3 mm  $\varnothing$  apically, terete or slightly compressed, with minute cracks initiating from elongated lenticels. *Bud* 10–14 by 3–5 mm, narrowly conical, obtuse. *Stipule* c. 5 cm long, narrowly lanceolate. *Leaves* 8–15 by 4–10 cm, elliptic to ovate, base obtuse; apex shortly acuminate; nerves 12–20 pairs, usually dense, at 40°–50°; *petiole* 2–2.5 cm long. *Raceme* to 9 cm long, terminal or axillary, terete, shortly pale brown tomentose or glabrescent, singly branched. *Flower bud* to 25 by 8 mm. *Calyx* and *corolla* typical, calyx shortly tomentose. *Stamens* c. 30, exceeding the style; filaments short; anthers linear; appendage to connective c. 2 times length of anther, filiform, tapering, sparsely setose. *Ovary* ovoid-conical, tapering into the stylopodium; stylopodium and style slender, filiform, tomentose in the basal half. *Fruit calyx* glabrous; tube to 2 cm  $\varnothing$ , smooth, globose; 2 longer lobes to 14 by 2.5 cm, narrowly spatulate, obtuse, to 1 cm broad at base; 3 shorter lobes to 2.2 by 1 cm, ovate, constricted at base, the 2 sides becoming revolute back to back.

Distr. Andamans, Chittagong, Burma, S.E. and Peninsular Thailand, and in *Malesia*: Malaya, Sumatra, W. Java, Borneo (Sampit and the Rejang valley eastwards), Philippines.

Ecol. Very widespread, often gregarious in seasonal semi-evergreen dipterocarp forest on red soils; becoming scattered, rare, and confined to fertile red soils, in everwet areas (*cf. Anisoptera costata*), below 800 m.

Vern. *Kěruing kesat*, *k. bungoh*, *k. daun halus* (Mal.), *wuluk bulan* (Jav.), *bembang* (Sum.). Philip-

pines: *agan-an* (Bicol), *duha* (Ibn.), *kurimau* (Ibn.), *lalian* (Tag.), *lanutan* (Neg.), *lauan* (Zamb., Sul.), *pagsa hingau* (Tag.), *palamopang* (Tag.), *palohap* (Sbl.), *pamalalian* (Cag., Ibn.), *pamantulen* (Ilk.), *pamantuling* (Pang.), *Pamarnisen* (Ibn.), *panao* (Tag., Pang., Sbl., Ibn., Pamp.), *putsa hingan* (Tag.), *sitam* (Ibn.).

Note. Specimens from the Indo-Burmese region and northern Malaya, and also the Philippines are usually more shortly sparsely evenly pubescent.

7. *Dipterocarpus baudii* KORTH. Kruidk. (1841) 59, t. 5; WALP. Rep. 5 (1845) 123; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 36; MIQ. Fl. Ind. Bat. 1, 2 (1859) 497; Sum. (1862) 485; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; SCHEFFER, Nat. Tijds. N. I. 31 (1870) 346; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 198; HEYNE, Nutt. Pl. ed. 2 (1927) 1095; FOXW. Mal. For. Rec. 3 (1927) 42; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 273; PARKER, Ind. For. Rec. 16 (1931) 3; PARKINSON, Burma For. Bull. 27 (1932) 11; FOXW. Mal. For. Rec. 10 (1932) 64; BURK. Dict. (1935) 842; SYM. Mal. For. Rec. 16 (1943) 168, f. 85. — *D. duperreana* PIERRE in Lanessan, Pl. Util. Colon. Fr. (1886) 297; Fl. For. Coch. 3 (1889) t. 219; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 7, 28; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 358; RIDL. Fl. Mal. Pen. 1 (1922) 214; CRAIB, Fl. Siam. Enum. 1 (1925) 134. — *D. scortechinii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 91; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 28; BURK. J. Str. Br. R. As. Soc. 81 (1920) 55, fig.; HEYNE, Nutt. Pl. ed. 2 (1927) 1095; FOXW. Mal. For. Rec. 10 (1932) 64. — *D. pilosus* (non ROXB.) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 27, *p.p.*; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 244, *p.p.*; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 224; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 251; FOXW. Mal. For. Rec. 3 (1927) 42.

Large tree. Leaf buds, stipules outside, twigs, petiole and inflorescences densely persistently long tufted rufous tomentose, leaf beneath and midrib above, ovary apex, calyx and petals outside shortly so; fruit calyx and leaves above glabrescent. *Twig* c. 4–6 mm  $\varnothing$  apically, stout. *Bud* c. 15 by 8 mm, lanceolate; *stipule* to 15 by 3 cm, lorate-lanceolate, becoming sparsely tufted tomentose after expansion, tinged red. *Leaves* 17–32 by 8–17 cm,  $\pm$  elliptic, thinly coriaceous, drying rufous below, dark purplish above; base narrowly obtuse; acumen to 2 cm long, tapering; nerves 14–28 pairs, ascending, stoutly prominent beneath; tertiary nerves dense; midrib prominent beneath, applanate above; *petiole* 3–5 cm long, c. 3 mm  $\varnothing$ . *Raceme* to 6 cm long, axillary, generally unbranched, bearing to 6 distichous flowers. *Flower bud* to 3 by 1 cm. *Stamens* 30, exceeding style at anthesis; filaments slender,  $\frac{1}{4}$  length of the linear tapering anthers; appendage acicular, c.  $\frac{1}{3}$  length of anthers; *ovary* small, ovoid, pubescent; style stoutly columnar, pubescent but for the apical  $\frac{1}{4}$ . *Fruit* subsessile, *pedicel* to 2 by 2 mm; *calyx tube* to 2 cm  $\varnothing$ , globose; 2 longer lobes to 18 by 3 cm, lorate, obtuse, c. 6 mm wide at base; 3 shorter lobes to 2 by 1 cm, elliptic.

Distr. Cochinchina, Cambodia, Burma, Thailand, and in *Malesia*: Malaya, Sumatra (Atjeh south to Padang highlands in W., and river Kampar in east, southwards to Peranap).

Ecol. Lowland forest, undulating land.

Vern. *Kéruing bulu*, *k.dadeh*, *k. sudoi*, *damar etoi*, *d. minyak*, *néram bukit*, *stui*, *térak* (Malaya); *lagan*, *kéruing*, *marakeleowan* (Sumatra).

Note. Confused in the past with *D. gracilis*, from which it differs in longer tomentum and larger size of all parts. The related *D. elongatus* KORTH., and also *D. hispidus* THW. of Ceylon which differs in having a cordate leaf with at most 16 pairs of nerves, would appear to be geographical segregates.

**8. *Dipterocarpus obtusifolius*** TEYSM. ex MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 214; DC. Prod. 16, 2 (1868) 608; WALP. Ann. 7 (1869) 377; DYER, Fl. Br. Ind. 1 (1874) 295; KURZ, Fl. Burma 1 (1877) 115; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 7, 27; Ind. Trees (1906) 65, 701; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 358; RYAN & KERR, J. Siam Soc. 8 (1911) 3, *incl. var. subnudus* RYAN & KERR; TROUP, Silv. Ind. Trees (1921) 39; CRAIB, Fl. Siam. Enum. (1925) 136; PARKER, Ind. For. Rec. 16 (1941) 9; PARKINSON, Burma For. Bull. 27 (1932) 23; TARDIEU, Fl. Gén. I.-C. Suppl. 1 (1943) 338; SYM. Mal. For. Rec. 16 (1943) 184, f. 85; SMITINAND, Thai For. Bull. 1 (1954) 51, *incl. var. glabricalyx et var. vestitus* SMITINAND; ASHTON, Gard. Bull. Sing. 31 (1978) 7. — *D. vestitus* WALL. [Cat. (1828) 954; WALP. Rep. 5 (1845) 124; DC. Prod. 16, 2 (1868) 614, *nomen*] ex DYER, Fl. Br. Ind. 1 (1874) 295; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 270. — *D. punctulatus* PIERRE, Fl. For. Coch. 3 (1889) t. 221; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 29; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 357.

Small or medium-sized, usually misshapen and often coppiced tree with open crown and thick, corky deeply fissured bark. Twigs, leaf buds and petioles densely pale fulvous to buff hirsute or glabrous; leaf beneath and midrib above shortly densely evenly persistently buff pubescent, with the nervation more, or less (Malaya), hirsute; fruit glabrescent. *Twig* c. 7 mm  $\varnothing$  apically, stout. *Bud* to 20 by 6 mm, lanceolate, subacute; *stipules* to 7 by 1 cm, lorate, obtuse. *Leaves* 14–22 by 10–16 cm, broadly ovate, thickly coriaceous, prominently plicate, crenate in the distal  $\frac{1}{2}$ ; base obtuse or subcordate; apex obtuse or subacute; nerves 14–20 pairs, stout, prominent beneath, ascending; petiole 2.5–4 cm long, c. 4 mm  $\varnothing$ , stout. *Flower bud* to 2.5 by 1.2 cm; *stamens* c. 30,  $\pm$  equalling style at anthesis; filaments lorate, tapering c.  $\frac{1}{2}$  as long as the relatively stout tapering lorate anthers; appendage acicular, c.  $\frac{3}{4}$  as long as anther; *ovary* ovoid, pubescent, surmounted by a slender columnar style  $\pm$  thrice its length and pubescent in the basal  $\frac{1}{2}$ . *Fruit pedicel* to 2 by 3 mm, short; *calyx tube* to 2.5 cm  $\varnothing$ , subglobose, smooth; 2 longer lobes to 15 by 3 cm, lorate-spatulate, obtuse, abruptly tapering to c. 8 mm broad at the subrevolute base; 3 shorter lobes to 15 by 10 mm, ovate, obtuse, subrevolute.

Distr. Burma, Thailand, Indochina, and in *Malesia*: N. W. Malaya (Perlis).

Ecol. Rare, in *Schima*-bamboo forests in *Malesia*. Elsewhere a characteristic and frequently gregarious fire-resistant component of the Dry Dipterocarp (savanna) forest.

Note. Very variable, especially in the amount and density of tomentum, the more glabrous form (*var. subnudus* RYAN & KERR) prevailing in the more humid areas including N.W. Malaya; in this respect resembling other dipterocarp species of the seasonal regions, e.g. *Dipterocarpus turbinatus*, *Anisoptera costata*, *Shorea siamensis*.

**9. *Dipterocarpus rotundifolius*** Foxw. Mal. For. Rec. 10 (1932) 73, pl. 4; BURK. Dict. (1935) 845; SYM. Mal. For. Rec. 16 (1943) 188, f. 85.

Twigs, leaf buds, stipules outside, petiole and leaf nervation beneath sparsely very long tufted golden tomentose (especially saplings and young trees) or glabrous; parts of petals exposed in bud and ovary densely shortly evenly buff puberulent. *Twig* c. 5 mm  $\varnothing$  apically, dark brown suffused with pale grey, minutely verrucose-lenticellate; stipule scars prominent. *Buds* to 4 by 2 cm, enormous, ellipsoid, obtuse; *stipules* to 9 by 5 cm, elliptic, obtuse, concave. *Leaves* 8.5–16 by 8–15 cm, broadly ovate to suborbicular, thickly coriaceous; base obtuse to cordate; apex subacuminate or more typically obtuse; margin undulate, subrevolute; nerves 11–(13) pairs, spreading, sharply prominent beneath, shallowly depressed above; tertiary nerves remotely scalariform, distinctly elevated beneath; *petiole* 4–10 cm long, 2–3 mm  $\varnothing$ , very long. *Flowers* solitary on the 6 cm long axillary peduncles, subtended and enclosed in a large, to 5 by 3 cm, elliptic obtuse concave subsistent bract; *stamens* 30, greatly exceeded by style at anthesis; filaments slender, columnar, short; anthers long, linear, tapering, prominently auriculate; appendage acicular, slender, c.  $\frac{1}{2}$  length of anthers; *gynoeceum* puberulent but for the distal  $\frac{1}{3}$  of the style; ovary small, ovoid; style slender, filiform, tapering, very long. *Fruit pedicel* to 5 by 4 mm, expanding into the to 18 by 14 mm fusiform-ellipsoid smooth *calyx tube*; 2 longer lobes to 9 by 2.5 cm, oblong, obtuse, c. 7 mm wide at base, 3-nerved, the lateral 2 nerves short and the central prominently laterally branched; 3 shorter lobes to 14 by 7 mm, elliptic, obtuse, subrevolute.

Distr. *Malesia*: Malaya (Perak, and Trengganu southwards on east coast).

Ecol. Local, in Mixed Dipterocarp forest on coastal hills.

Vern. *Kéruing mengkai*.

Note. A curious and distinct form which is clearly related to the widespread *D. crinitus*.

**10. *Dipterocarpus chartaceus*** SYM. Gard. Bull. S.S. 9 (1938) 322; Mal. For. Rec. 16 (1943) 169, f. 85, 86. — *D. skinneri* var. *hirtus* RIDL. Fl. Mal. Pen. 1



(1922) 215; SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 295. — *D. skinneri* (non KING) RIDL. Fl. Mal. Pen. 1 (1922) 214, p.p.; Foxw. Mal. For. Rec. 10 (1932) 70, p.p.

Large tree. Twig, leaf bud, stipule, inflorescence, flower calyx, ovary apex and petals outside densely persistently shortly golden pubescent; leaf undersurface sparsely caducously so; fruit glabrescent. *Twig* c. 4 by 3 mm  $\varnothing$ , pale brown, somewhat compressed. *Buds* to 7 by 3 mm, lanceolate-falcate; *stipules* to 8 by 9.8 cm, lorate-lanceolate. *Leaf* 8.5–19 by 4–9 cm, elliptic-ovate or rarely obovate, crisply chartaceous drying pale mauve and somewhat lustrous; base cuneate; acuminate to 1 cm long, tapering; nerves 10–12(–14) pairs, slender but distinctly elevated beneath, ascending; tertiary nerves densely scalariform, hardly elevated; *petiole* 2.3–2.8 cm long, c. 2 mm  $\varnothing$ , slender. *Raceme* to 6 cm long, axillary, singly branched or unbranched, bearing to 6 flowers. *Flower buds* to 22 by 8 mm, fusiform-lanceolate. *Stamens* 30, shorter than style at anthesis; filaments compressed at base, tapering rapidly and then filiform, c.  $\frac{1}{2}$  length of the relatively short linear tapering anthers; appendage acicular, c.  $\frac{3}{4}$  length of anther; *ovary* narrowly ovoid, pubescent, tapering into the long slender filiform style; style glabrous in apical  $\frac{1}{3}$ . *Fruit pedicel* c. 1 by 2 mm, short; *calyx tube* to 18 mm  $\varnothing$ , subglobose; 2 longer lobes to 13 by 3.2 cm, lorate, somewhat tapering distally, obtuse, c. 7 mm broad and revolute at base; 3 shorter lobes to 4 by 4 mm, orbicular, revolute.

Distr. Peninsular Thailand, and in *Malesia*: Malaya.

Ecol. Infrequent in lowland forest, sometimes in areas periodically inundated, especially in seasonal areas and near coast.

Vern. *Kěruing kertas* (Mal.).

Note. The fallen leaf is crisp and papery, drying pale buff.

**11. *Dipterocarpus caudatus*** FOXW. Philip. J. Sc. 13 (1918) Bot. 177; *ibid.* 67 (1938) 256; MERR. En. Philip. 3 (1923) 89; SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 302, 303; ASHTON, Gard. Bull. Sing. 31 (1978) 8.

**a. ssp. *caudatus*.**

Leaf bud and stipule outside shortly densely pale buff pubescent. Parts otherwise glabrous. *Twig* 1–3 mm  $\varnothing$  apically, slender,  $\pm$  compressed, smooth, with slightly swollen amplexicaul stipule scars. *Bud* 8–17 by 2–3 mm, narrowly falcate or linear; apex tufted with slightly longer hairs arising from the outer surface. *Stipule* c. 3.5 by 0.5 cm, linear, obtuse. *Leaves* 7–11 by 3.5–5 cm, broadly elliptic,  $\pm$  prominently plicate; base broadly cuneate; acuminate to 1.2 cm long, prominent, narrow; nerves 9–12 pairs, prominent, at 35°–45°; *petiole* 1–1.5 cm long, slender. *Raceme* to 12 cm long, slightly compressed; unbranched or singly branched, the flowers secund, few; *bracts* unknown. *Flower bud* to 3 by 0.8 cm. *Calyx* and *corolla* typical, calyx puberulent. *Stamens* c. 30, shorter than the style;

filaments short; anthers short, linear, tapering; appendage to connective slightly shorter than anther, stout at base, tapering. *Ovary* conical, densely pubescent; style and stylopodium narrowly cylindrical, somewhat stouter and more densely tomentose in the basal half. *Fruit calyx* glabrous tube c. 2 cm long and  $\varnothing$ , slightly obovoid, glabrous, minutely lenticellate, tapering gradually to the pedicel, c. 1 cm  $\varnothing$  at the neck; 2 longer calyx lobes to 14 by 3 cm, oblong, 3-nerved, obtuse, rather abruptly narrowing to c. 5 mm broad at base; 3 shorter lobes 4–8 by 3–4 mm, variable, strongly recurved and revolute.

Distr. *Malesia*: S. E. Philippines (Mindanao, Luzon).

Ecol. Local in everwet zone.

**b. ssp. *penangianus*** (FOXW.) ASHTON, Gard. Bull. Sing. 31 (1978) 8. — *D. penangianus* FOXW. Mal. For. Rec. 10 (1932) 72, pl. 3 (germ. seeds); SYM. Mal. For. Rec. 16 (1943) 185, f. 85; ASHTON, Man. Dipt. Brun. (1964) 43, f. 6–7; *ibid.* Suppl. (1968) 16.

Twig, petiole, raceme, midrib and nerves shortly sparsely fugaceous pubescent, twigs sometimes densely persistently so. Leaves narrowly elliptic, applanate, with narrowly cuneate base, hardly prominent nerves beneath and 1.5–2.5 cm long petiole.

Distr. *Malesia*: Malaya (Perak, Penang, W. & E. Johore, Kelantan, Pahang), Singapore, Sumatra (Karimun, Musala), Borneo (Sarawak N.E. of river Rejang, S.E. Sabah).

Ecol. Coastal hills, locally frequent.

Vern. *Kěruing gasing*, *k. dēran*, *songgi dēran*.

Note. Malayan collections are distinguished by their denser more persistent indumentum on twigs, and by their prominently lenticellate fruit calyx tube.

**12. *Dipterocarpus kerrii*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 93; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 28; BURK. J. Str. Br. R. As. Soc. 81 (1920) 55, fig.; RIDL. Fl. Mal. Pen. 1 (1922) 215; CRAIB, Fl. Siam. Enum. 1 (1925) 136; SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 295; PARKER, Ind. For. Rec. 16 (1931) 15; PARKINSON, Burma For. Bull. 27 (1932) 19; FOXW. Mal. For. Rec. 10 (1932) 69; BURK. Dict. (1935) 844; Philip. J. Sc. 67 (1938) 253; SYM. Mal. For. Rec. 16 (1943) 181, f. 85, 92; SMITINAND, Thai For. Bull. 1 (1954) 4; *ibid.* 4 (1958) 38; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 259, f. 40. — *D. obconicus* FOXW. in Elmer, Leaf. Philip. Bot. 6 (1913) 1951; Philip J. Sc. 13 (1918) Bot. 178; MERR. En. Philip. 3 (1923) 90; SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 299. — *D. perturbanatus* FOXW. Philip. J. Sc. 13 (1918) Bot. 177. — *D. cuneatus* FOXW. Philip. J. Sc. 13 (1918) Bot. 178; MERR. En. Philip. 3 (1923) 89; SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 300.

Large tree. Parts of petals exposed in bud, inside of stipules and ovary apex densely silky cream pubescent, parts otherwise glabrous. *Twig* c. 3 mm  $\varnothing$ , subterete, blackish, minutely pale lenticellate. *Bud* to 12 by 3 mm, lanceolate-falcate, drying black; *stipule* to



Fig. 23. The sacred forest of Sangeh in Bali, bordering on rice-field, consisting of *Dipterocarpus hasseltii* BL. (Photogr. DE VOOGD).

8 by 0.5 cm, linear-lanceolate, subacute. *Leaves* 8–13 by 3.3–7 cm,  $\pm$  broadly elliptic, coriaceous, drying dark chocolate-brown; base cuneate; acumens to 5 mm long, short, nerves (7–)9–11 pairs, slender but prominent beneath, ascending; tertiary nerves densely scalariform, very slender and barely elevated beneath; *petiole* 2–2.8 cm long, slender. *Inflorescence* to 8 cm long, singly branched or unbranched, bearing up to 5 flowers. *Flower buds* to 2.5 by 1 cm. *Stamens* c. 30, exceeding style at anthesis; filaments filiform, slender, c.  $\frac{1}{3}$  length of the short linear-lorate  $\pm$  tapering subauriculate anthers; appendage acicular, slender, c.  $\frac{1}{2}$  length of anther; *ovary* small, ovoid, puberulent as also the basal  $\frac{1}{2}$  of the stoutly columnar style. *Fruit pedicel* to 3 by 3 mm, stout. *Fruit calyx* to 3.5 cm  $\varnothing$ , globose to subtrubinate, smooth; 2 longer lobes to 14 by 3 cm, lorate, tapering apically, obtuse, abruptly constricted to c. 8 mm wide and subrevolute at base; 3 shorter lobes to 1 by 1 cm, prominent, suborbicular, subrevolute.

*Distr.* Andamans, Burma, Peninsular Thailand and in *Malesia*: Malaya (Malacca and Pahang northwards, coastal towards south of range), Sumatra (Indragiri), N. Borneo (Sandakan area), Philippines.

*Ecol.* Semi-evergreen and evergreen coastal dipter-

ocarp forests in periodically or seasonally dry climates, on red lateritic soils, on undulating land and hills below 400 m; frequently gregarious.

*Vern.* *Kêruing gondol*, *k. chair*, *damar minyak* (Malaya), *apitong*, *panao*, *malapanao*, *palsahingan* (Philippines).

**13. *Dipterocarpus hasseltii* BL.** Fl. Jav. 2 (1829) 22, t. 6; KORTH. Kruidk. (1841) 65; WALP. Rep. 5 (1845) 123; MIQ. Fl. Ind. Bat. 1, 2 (1859) 497; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; BURCK, Ann. Jard. Bot. Btsg 6 (1887) 196; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 30; K. & V. Bijdr. 5 (1900) 109; RIDL. J. Str. Br. R. As. Soc. 33 (1900) 42; *ibid.* 34 (1900) 94; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 359; KOORD. Exk. Fl. Java 2 (1912) 620; BAKER f. J. Bot. 62 (1924) 10; CRAIB, Fl. Siam. Enum. 1 (1925) 135; HEYNE, Nutt. Pl. ed. 2 (1927) 1096, 1097; SLOOT. Bull. Jard. Bot. Btsg III, 8 (1927) 280; *ibid.* III, 16 (1940) 436; Foxw. Mal. For. Rec. 10 (1932) 67; Philip. J. Sc. 67 (1938) 251; BURK. Dict. (1935) 844; Mal. For. Rec. 16 (1943) 180, f. 85, 91; SMITINAND, Thai For. Bull. 4 (1958) 35; BACKER & BAKH. f. Fl. Java 1 (1963) 329; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 255; ASHTON, Gard. Bull. Sing. 31 (1978) 8. — *D. tam-*



*purau* KORTH. Kruidk. (1841) 63; WALP. Rep. 5 (1845) 123; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 36; MIQ. Fl. Ind. Bat. 1, 2 (1859) 498; ANN. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; DYER, J. Bot. 12 (1874) 103; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 198, p.p.; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 29; MERR. En. Born. (1921) 400; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 292, f. 1; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 274; *ibid.* ed. 2 (1927) 1098; cf. ASHTON, Gard. Bull. Sing. 20 (1963) 234. — *D. quinquegonus* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 36; WALP. Ann. 4 (1857) 335; MIQ. Fl. Ind. Bat. 1, 2 (1859) 497; ANN. Mus. Bot. Lugd.-Bat. 3 (1867) 85; MERR. En. Born. (1921) 400. — *D. pentagonus* DC. Prod. 16, 2 (1868) 610; DYER J. Bot. 12 (1874) 104; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 199; BRANDIS J. Linn. Soc. Bot. 31 (1895) 34; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 282. — *D. lamponus* SCHEFF. Nat. Tijds. N. I. 31 (1870) 146; DYER, J. Bot. 12 (1874) 102; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 197; BRANDIS, J. Linn. Soc. Bot. (1895) 31; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 272; ASHTON, Gard. Bull. Sing. 20 (1963) 236, *in obs. sub D. gracilis*. — *D. balsamiferus* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 37; MIQ. Fl. Ind. Bat. 1, 2 (1859) 498; ANN. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 613; DYER, J. Bot. 12 (1874) 108; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 203; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40; K. & V. Bijdr. 5 (1900) 111; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 357; HEYNE, Nutt. Pl. ed. 2 (1927) 1096. — *D. trinervis* (non BL.) FOXW. Philip. J. Sc. 6 (1911) Bot. 247; *ibid.* 13 (1918) Bot. 177; MERR. En. Philip. 3 (1923) 91. — *D. subalpinus* FOXW. in Elmer, Leaflet. Philip. Bot. 6 (1913) 1950; Philip. J. Sc. 13 (1918) Bot. 177; *ibid.* 67 (1938) 255; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 283. — **Fig. 23, 24.**

Parts of petals expanded in bud and ovary apex densely persistently buff puberulent, calyx at first frequently so, nerves beneath sparsely so or glabrescent, otherwise glabrous. *Twig* c. 4 by 2 mm  $\varnothing$  apically, somewhat compressed, black. *Buds* to 20 by 5 mm, falcate-lanceolate, drying black; *stipules* to 12 by 1 cm, lorate-lanceolate, subacute. *Leaves* 9–16 by 5–10 cm, elliptic, subcoriaceous, prominently plicate; margin  $\pm$  prominently crenate; base cuneate; acumen to 1 cm long, short; nerves 11–14 pairs, slender but prominent beneath, ascending; *petioles* 2.5–4 cm long, slender. *Inflorescences* to 10 cm long, axillary, bearing to 4  $\pm$  secund flowers. *Flower buds* to 3 by 1 cm, fusiform. *Stamens* 30, shorter than style at anthesis; filaments c.  $\frac{1}{2}$  length of anthers, long, broad and compressed at base, rapidly tapering and filiform above; anthers linear, somewhat tapering distally; appendage acicular, very slender, c.  $\frac{2}{3}$  length of anther. *Ovary* narrowly ovoid-lanceolate, tapering into the very long slender filiform style; gynoeceum puberulent except for the distal  $\frac{1}{4}$ . *Fruit pedicel* to 3 by 2 mm; *calyx tube* to 3 cm  $\varnothing$ , subglobose smooth; 2 longer lobes to 22 by 3 mm, lorate-spatulate, usually obtuse, 3-nerved, c. 9 mm wide at base; 3 shorter lobes to 15 by 13 mm, suborbicular, subrevolute, prominent.

Distr. Peninsular Thailand, and in *Malesia* around



Fig. 24. Basal part of trunk of a relict tree of *Dipterocarpus hasseltii* BL. near a coffee estate, Getas, near Salatiga, Central Java (Photogr. ROEPKE, 1913).

the periodically dry borders of the everwet zone of the Sunda shelf: Malaya (Central and North), Sumatra (P. Simalur and Mentawai Is.), W. Java, Lesser Sunda Is. (Bali) and S. and E. Borneo to S.E. Sabah, Philippines including Palawan.

Ecol. Lowland dipterocarp forests on well-drained but moist fertile red soils in valleys and on hillsides, sometimes on calcareous soil, even limestone (Java); sometimes gregarious; to 600 m.

Notes. I agree with MERRILL (En. Philip. 3, 1923, 89) in reducing *D. subalpinus* FOXW., based on ELMER 13521 from Cabadbaran, Mt Urdaneta, Agusan Prov., Mindanao. FOXWORTHY (Philip. J. Sc. 67, 1938, 251) claimed that *D. subalpinus* differed from *D. hasseltii* in having smaller leaves and fruit without the distinctive large, suborbicular, shorter calyx lobes, in this resembling *D. gracilis* BL. The problem is confounded by the frequently unusually sparsely tomentose leaves of *D. gracilis* in the Philippines, especially at higher altitudes where *D. subalpinus* appears to prevail. However, the specimens presently available convinced me that Philippine material is within the range of variation of *D. hasseltii* from other parts of its range.

It is curious that, though this is clearly the species that is venerated in the sacred forest of Sanggeh, Bali collections from Lombok and Sumbawa Is., on a similar but clearly natural site in the former, appear to represent *D. retusus* (see there). I cannot distinguish these two species in Java or the Lesser Sunda Islands when young. Immature trees were seen to fruit abundantly in Sanggeh. There is the possibility of hybridization, in this part of the range, of these two otherwise very distinct species.

**14. *Dipterocarpus retusus*** BL. Cat. (1823) 77, *cum tab.*; Verh. Bat. Gen. K. W. 9 (1823) 178; Bijdr. (1825) 223; Fl. Jav. 2 (1829) 14, t. 2; WALP. Rep. 5 (1845) 122; MIQ. Fl. Ind. Bat. 1, 2 (1859) 497; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; DYER, J. Bot. 12 (1874) 102; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 197; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 256; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 30; K. & V. Bijdr. 5 (1900) 112; KOORD. Exk. Fl. Java 2 (1912) 21; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 251, 256, fig.; HEYNE, Nutt. Pl. ed. 2 (1927) 1097; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 286; *ibid.* III, 16 (1940) 435; FOXW. Mal. For. Rec. 10 (1932) 69; SYM. For. Rec. 16 (1943) 187, f. 85; BACKER & BAKH. f. Fl. Java 1 (1963) 329; ASHTON, Gard. Bull. Sing. 31 (1978) 9. — *D. trinervis* BL. Cat. (1823) 78; Verh. Bat. Gen. K. W. 9 (1823) 178; Bijdr. (1825) 223; Fl. Jav. 2 (1829) 11, t. 1, *incl. var. elegans* BL. *et var. canescens* BL.; KORTH. Kruidk. (1841) 61; WALP. Rep. 5 (1845) 122; LINDLEY, Veg. King. (1846) 393; HASSK. Pl. Jav. Rar. (1848) 270; SCHNIZLEIN, Ic. 3 (1857) t. 213; MIQ. Fl. Ind. Bat. 1, 2 (1859) 496; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 608; SCHEFF. Nat. Tijd. N. I. 31 (1870) 346; BAILLON, Hist. Pl. 4 (1873) 204; Dict. Bot. 1 (1878) 562; Tr. Bot. Med. Pharm. 2 (1884) 816; DYER, J. Bot. 12 (1875) 102; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 195; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 256; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 29; K. & V. Bijdr. 5 (1900) 105; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 354; KOORD. Exk. Fl. Java 2

(1912) 620; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 274; *ibid.* ed. 2 (1927) 1098; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 251, 256, fig.; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 284; *ibid.* III, 16 (1940) 436; BACKER & BAKH. f. Fl. Java 1 (1963) 329. — *D. spanoghei* BL. Fl. Jav. 2 (1829) 16, t. 3; WALP. Rep. 5 (1845) 122; MIQ. Fl. Ind. Bat. 1, 2 (1859) 497; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 198, *incl. var. cordata* BURCK; HEYNE, Nutt. Pl. ed. 2 (1927) 1097. — *D. macrocarpus* VESQUE, C. R. Ac. Sc. Paris 78 (1874) 627; J. Bot. 12 (1874) 151; DYER, J. Bot. 12 (1874) 153; PARKER, Ind. For. Rec. (Bot.) 20, 15 (1934) 3. — *D. pubescens* K. & V. Bull. Inst. Bot. Btzig 2 (1899) 2; Bijdr. 5 (1900) 115; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 359; KOORD. Exk. Fl. Java 2 (1912) 621; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 274; *ibid.* ed. 2 (1927) 1097. — *D. tonkinensis* A. CHEV. Bull. Econ. Indochine 20 (1918) 798. — **Fig. 17H.**

Medium-sized tree. Twigs, panicles, flower calyx and corolla outside shortly densely buff puberulent or glabrous; petiole, leaf bud and ovary densely persistently pale orange-rufous silky tomentose or glabrous, stipule caducously so, becoming tufted glabrescent on expanding; leaf glabrescent. *Twigs* c. 8 mm  $\varnothing$  apically, stout, becoming pale brown. *Buds* to 2.5 by 1 cm, ovoid-lanceolate, acute; *stipule* to 4 cm long, lanceolate, acute. *Leaves* 16–28 by 7–17 cm (to 50 by 70 cm in young trees),  $\pm$  broadly elliptic-oblong, coriaceous, prominently plicate, drying dark chocolate-brown; nerves 16–19 pairs, prominent beneath,  $\pm$  depressed above, ascending; tertiary nerves densely scalariform, very slender and hardly elevated beneath; *petiole* 2.5–7 cm long. *Panicles* to 10 cm long, unbranched, axillary. *Flower bud* to 3 by 1 cm, fusiform. *Stamens* 30, exceeding style at anthesis; filaments short, filiform; anthers long, linear, tapering; appendage acicular, slender, c.  $\frac{1}{2}$  length of anther. *Ovary* small, ovoid, densely pubescent as also the basal  $\frac{2}{3}$  of the stoutly columnar somewhat tapering style. *Fruit pedicel* to 3 by 4 mm, stout; calyx tube to 3.5 mm  $\varnothing$ , subglobose, sparsely minutely pale lenticellate, smooth; 2 longer lobes to 25 by 4.5 cm, obtuse, prominently 3-nerved, tapering abruptly to c. 12 mm wide at base; 3 shorter lobes to 2 by 1.5 cm, prominent, ovate-elliptic, obtuse, subrevolute.

Distr. Assam, N.W. Burma, N., S.E. & Peninsular Thailand, Tonkin, and in *Malesia*: Malaya, Sumatra (Gajo Lands, Angkola), Java, Lesser Sunda Is. (Lombok, Sumbawa).

Ecol. Moist evergreen mid-mountain forests, at 800–1300 m in Malaya and W. Java but at lower altitudes in seasonal areas, and as low as 100 m at Lakhimpur, Assam and Lombok; locally common or semi-gregarious.

Vern. *Këruing gunong* (Malaya), *pelahlar*, *palaglar* (Java).

Notes. The distribution, persistence and density of the tomentum is very variable, even within a single population, in E. Java and Burma; in Assam, N. Burma and N. Thailand even the leaves are typically



persistently pubescent beneath, while in Malaya it is uniformly glabrescent but for the buds and corolla.

The species, as here understood, has an interesting distribution: at the extremities of its range in mainland Asia and in the Lesser Sunda Is. (Lombok and Sumbawa) it occurs in a seasonal climate down almost to sea level and is relatively tomentose. In the everwet tropics of Malaya and W. Java it is confined to altitudes above 800 m and in the former is uniformly glabrescent but for the buds and corolla.

*D. littoralis* is clearly a segregate from the widespread *D. retusus*, endemic to the lowland forest of Nusa Kambangan I., adjacent to the coast of S. Central Java. I maintain it as a species. It would appear that the ecological and geographical distribution, and diversification, of the two must be explained in terms of regional Pleistocene history.

**15. *Dipterocarpus littoralis*** BL. Bijdr. (1825) 224; Fl. Jav. 2 (1829) 17, t. 4; KORTH. Kruidk. (1841) 62; WALP. Rep. 5 (1845) 122; MIQ. Fl. Ind. Bat. 1, 2 (1859) 496; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 609; DYER, J. Bot. 12 (1874) 102; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 198; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 30; K. & V. Bijdr. 5 (1900) 114; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 348; KOORD. Exk. Fl. Java 2 (1912) 621; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 296, f. 2; BACKER & BAKH, f. Fl. Java 1 (1963) 329.

Young parts  $\pm$  densely pale ferrugineous pubescent, persistent only on leaf bud, stipule outside and ovary, becoming sparse though subsistent on petiole and midrib above. *Twigs* 8–11 mm  $\varnothing$ , stout, terete, rough, with prominent large petiole scars. *Bud* c. 20 by 15 mm, ovoid-lanceolate. *Stipule* to 15 by 4 cm, lanceolate, acute, caducous. *Leaves* clustered round the twig apices, 16–25(–52 in young trees) by 10–18(–28) cm, broadly ovate, thinly coriaceous,  $\pm$  prominently persistently plicate; base obtuse or cordate; apex shortly acuminate; nerves 19–24 pairs, straight, at 60°–70°, prominent beneath; tertiary nerves laxly scalariform, slender but distinctly elevated beneath; midrib prominent beneath, appanate or somewhat elevated above; *petiole* 3–9(–12) cm long, prominently geniculate. *Inflorescences* to 20 cm long, glabrous, axillary and crowded round the twig apices, lax, compressed, bearing to 3 flowers. *Flower buds* to 35 by 10 mm, prominently pedicellate. *Stamens* c. 30; filaments tapering, anthers narrowly tapering, auriculate, pubescent; appendages shorter than anthers. *Fruit pedicel* to 5 by 4 mm, prominent; *calyx tube* to 3.5 by 3 cm, obturbinate, smooth; 2 longer lobes to 24 by 4 cm, lorate, narrowly obtuse or subacute, c. 7 mm broad and somewhat revolute at base; 3 shorter lobes to 10 by 6 mm, obtuse, with revolute margins.

Distr. *Malesia*: Central S. Java (Nusa Kambangan I. in Banjumas Res.).

Ecol. Apparently common in the mixed lowland rain forest.

Vern. *Lalar*, *pělahlar*, *kalahlar* (Jav.).

Note. Apparently a lowland segregate of the widespread submontane *D. retusus*. A collection at Leiden (DE VRIESE s.n. sub n. 902. 146–236) is presumably wrongly annotated as from Sumatra.

**16. *Dipterocarpus kunstleri*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 96; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 148, t. 180; RIDL. Fl. Mal. Pen. 1 (1922) 217; HEYNE, Nutt. Pl. ed. 2 (1927) 1094, 1096; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 327; FOXW. Mal. For. Rec. 10 (1932) 83; BURK. Dict. (1935) 844; SYM. Mal. For. Rec. 16 (1943) 182, f. 85; ASHTON, Gard. Bull. Sing. 31 (1978) 10. — *D. speciosus* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 38; PERK. Fragm. Fl. Philip. (1904) 22; FOXW. Philip. J. Sc. 6 (1911) Bot. 250, pl. 37; *ibid.* 13 (1918) Bot. 178; *ibid.* 67 (1938) 261; MERR. En. Philip. 3 (1923) 90; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 265. — *D. exaltatus* SLOOT. ex WOOD, Gard. Bull. Sing. 17 (1960) 486; Reinwardtia 5 (1961) 462; ASHTON, Man. Dipt. Brun. (1964) 31, f. 6; *ibid.* Suppl. (1968) 14; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 246, pl. 25b. — **Fig. 17D.**

Twig, lamina and petiole glabrous; leaf nervation puberulent or glabrous beneath; leaf bud and stipule outside persistently densely minutely pale grey adpressed puberulent, appearing grey lepidote. *Twig* to 5 mm  $\varnothing$  apically, terete or slightly ribbed and compressed; stipule scars prominent. *Bud* 12–15 by 2–3.5 mm, narrowly falcate, acute. *Stipule* to 7 by 0.8 cm, linear. *Leaves* 13–22 by 7–10 cm, elliptic to broadly lanceolate, base cuneate; apex shortly acuminate (more prominently acuminate in young trees); nerves 16–18 pairs, prominent beneath, at c. 40° to 50°; *petiole* 2–3 cm long. *Raceme* to 22 cm long, terminal or axillary, slender, glabrous, somewhat compressed, singly branched. *Flower bud* to 3.5 by 1.5 cm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* c. 30, somewhat longer than the style; filaments short, anthers linear, tapering; appendage to connective as long as anther, slender. *Ovary* ovoid-conical, shortly densely pubescent; stylopodium and style about 5 times as long as the ovary, tapering from the base, shortly tomentose but for apical  $\frac{1}{4}$ . *Fruit calyx* glabrous; tube to 5 by 2.5 cm, ellipsoid, tapering gradually to the base and to the strongly constricted c. 1 cm  $\varnothing$  neck; 5-ribbed or almost winged, the ribs c. 7 mm thick and 4 mm broad apically, either confined to the apical half or continuing to the base as shallow rounded ridges, terminating  $\pm$  abruptly distally as obtuse tubercles; 2 longer lobes to 11 by 1.5 cm, of very variable length, sometimes no longer than shorter lobes, lanceolate, coriaceous, obtuse, tapering abruptly to the c. 5 mm broad base, 3-nerved, nerves indistinct; shorter lobes to 6 by 5 mm, small, recurved, somewhat thickened.

Distr. *Malesia*: Malaya (excluding seasonal area), Sumatra (Atjeh, Tapanuli, Palembang, in north, west and south-east; Simalur, Marsala, Banka), Borneo (S.E. Borneo, Sabah, Brunei, Sarawak N.E. of Rejang), Philippines (Luzon, Polillo, Negros, Samar, Basilan).

Ecol. Widespread, locally common, on undulating or flat land, especially near streams.

Vern. *Kéruing gombang*, *k.g. mērah* (Mal.), *k. batu*, *k. jombor*, *k. minyak*, *lagan laweh*, *l. daun lebar* (Sum.), *k. rapak*, *k. simpur*, *k. kuntum puteh*, *karang*, *binawan*, *kambalong*, *tempudau*, *isak*, *tabuloh*, *karup* (Borneo).

Note. In N.E. and E. Borneo the calyx tube is ± obtusely ribbed and tuberculate distally, and the wings often (not always) short or even rudimentary. In the Philippines the species becomes very variable; in some collections the fruit calyx tube is continuously ribbed from base to apex and even winged suggesting hybridisation with *D. grandiflorus* (BLCO) BL.; in others the twigs and petioles are densely fulvous pilose as in *D. elongatus* KORTH., which grows with it there.

Individual trees observed in the field in Borneo are rather constant in the length of the calyx lobes, but geographical variation appears continuous and to some extent clinal, the lobes becoming shorter towards the south-eastern limits of its range. I cannot therefore recognize distinct varieties meriting taxonomic status.

*D. speciosus* BRANDIS, based on VIDAL 2160 (in fruit, K) from Luzon, is a specimen with tomentum typical of *D. kunstleri* and fruit similar though with narrower, more continuous ribs. I see no satisfactory solution other than to unite the two names.

**17. *Dipterocarpus applanatus*** SLOOT. Bull. Jard. Bot. Btzg III, 16 (1940) 443, f. 5; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 237, f. 34; ASHTON, Man. Dipt. Brun. Suppl. (1968) 11, f. 2, pl. 1 (stem-base).

Twig, base of inflorescence and inside of stipule shortly evenly pale buff pubescent, base of petiole caducously so; leaf bud and stipule outside longer tomentose, longest towards apices. Twig 5–11 mm Ø, stout, pale with prominent slightly depressed dark stipule scars. Bud 4–15 by 10–27 mm, broadly ellipsoid to falcate, acute or obtuse. Stipule to 5 by 2 cm, oblong, obtuse, concave. Leaves 12–30 by 9–20 cm, usually large, ± broadly elliptic, coriaceous but undulate; base obtuse to subcordate; acumen short, abruptly acuminate; nerves 11–15 pairs, prominent, at 45°–70°; tertiary nerves remote, subreticulate; petiole 3.5–6 cm long, to 4 mm Ø. Flowers unknown. Raceme to 2 cm long, terete but rugose on drying, glabrescent, singly branched or bifurcating, bearing distichous fruit at c. 3 cm intervals. Fruit pedicel to 3 mm long, tapering from base of calyx tube; calyx tube to 5 by 4.5 cm, glabrous, ovoid, bearing 5, to 8 mm wide, prominent sharp-edged ribs; ribs widest distally and there frequently undulate, sometimes absent basally; 2 longer calyx lobes to 19 by 4.5 cm, glabrous, lorate, obtuse, tapering abruptly at the somewhat revolute base; 3 shorter calyx lobes to 1 by 1 cm, suborbicular, completely revolute.

Distr. *Malesia*: Borneo (W. Sarawak, E. Sabah, Tiding and Bulungan).

Ecol. Locally common on sandy soils, especially in valleys and on flat land near coasts.

Vern. *Kéruing arong*, *k. daun besar*.

Note. Apparently a segregate from *D. kunstleri*; it may have arisen more than once from the parental species.

**18. *Dipterocarpus rigidus*** RIDL. J. Str. Br. R. As. Soc. 82 (1920) 171; Fl. Mal. Pen. 1 (1922) 217; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 347; Reinwardtia 5 (1961) 463; FOXW. Mal. For. Rec. 10 (1932) 76, pl. 5; BURK. Dict. (1935) 845; DESCH. Mal. For. Rec. 14 (1941) 64; SYM. Mal. For. Rec. 16 (1943) 187, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 110; ASHTON, Man. Dipt. Brun. Suppl. (1968) 16, f. 3, pl. 2 (habit & bark).

Twig, petiole, midrib above and leaf beneath shortly densely evenly pale ochreous pubescent, leaf above fugaciously so; leaf bud and stipule outside (glabrous within in mature tree) longer tomentose. Twig to 8 mm Ø apically, stout, terete, with slender stipule scars. Bud to 15 by 8 mm, conical, subacute. Stipule to 7 by 1 cm, lorate, subacute. Leaves 13–25 by 8–16 cm, ovate, thickly coriaceous, with broadly cuneate base; acumen to 1 cm long; nerves 12–16 pairs, at 40°–50°; nerves and midrib prominent beneath, depressed above; tertiary nerves scalariform, evident beneath; petiole 3–6 cm long, geniculate. Raceme to 15 cm long, terete, axillary, at first shortly evenly ochreous pubescent towards the base, glabrescent; unbranched or rarely singly branched, bearing distichous flowers at up to 3 cm intervals. Flower bud to 3.5 by 1 cm. Calyx and corolla typical; calyx glabrous. Stamens 24, slightly shorter than the style; filaments narrowly lorate, slightly tapering, exceeding length of anthers; anthers linear, tapering; appendage acicular, c.  $\frac{1}{2}$  length of the anther. Ovary ovoid, pubescent; style columnar, pubescent except for the apical  $\frac{1}{4}$ . Fruit glabrous. Pedicel 1 mm long, stout. Calyx tube to 5 by 4.5 cm, subglobose, with 5 tubercles (obscure at maturity) in the distal half; 2 longer calyx lobes to 18 by 5 cm, lanceolate to lorate, subacute, to 6 mm broad above the somewhat revolute base; 3 shorter lobes to 8 by 8 mm, suborbicular, revolute.

Distr. *Malesia*: E. Malaya (Trengganu southwards), Sumatra (Riouw Arch., Singkep, Lingga), Anambas Is., Borneo (Sarawak N.E. to Bintulu).

Ecol. Locally abundant on dry sandy soils on coastal hills.

Vern. *Kéruing chogan*, *k. utap*, *k. sungkit*, *k. pakat*, *k. kēlawar*, *k. kēluang*, *k. mērah*, *k. lēkit*, *k. daun lebar*, *k. d. panjang* (Mal.).

Note. Sometimes difficult to distinguish from *D. costulatus* and *D. globosus*, both of which can be more or less tomentose when immature.

**19. *Dipterocarpus costulatus*** SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 315, f. 7; *ibid.* III, 17 (1941) 105; FOXW. Mal. For. Rec. 10 (1932) 79; SYM. Mal. For. Rec. 16 (1943) 174, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 108; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 244, pl. 25a (seedlings); ASHTON, Man. Dipt. Brun. Suppl. (1968) 12, f. 2.





abruptly at the c. 2.5 cm  $\varnothing$  neck; 2 longer calyx lobes to 18 by 5 cm, oblong, obtuse, tapering abruptly at the to 1.2 cm broad revolute base, untwisted; 3 shorter lobes to 1.5 cm long and broad, broadly ovate, base subcordate, apex obtuse, revolute with the 2 halves back to back.

Distr. *Malesia*: North and East Sumatra (Langsa; Singkel, Tapanuli, E. coast, Palembang, Mentawai Is.), Borneo (S.E. Kalimantan, Sabah, N.E. Sarawak, Brunei).

Ecol. Local, on undulating land and ridges below 700 m.

Vern. *Këruing kerukup*, *k. latek bukit* (Mal.).

Note. Clearly closely allied to *D. cornutus*, from which it differs principally in the tomentum and smooth fruit calyx.

**22. *Dipterocarpus cornutus*** DYER, Fl. Br. Ind. 1 (1874) 296; J. Bot. 12 (1874) 103, t. 143, f. 15; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 93; BRANDIS, J. Linn. Soc. Bot. (1895) 32; RIDL, Fl. Mal. Pen. 1 (1922) 215; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 306; HEYNE, Nutt. Pl. ed. 2 (1927) 727; Foxw. Mal. For. Rec. 10 (1932) 75; BURK, Dict. (1935) 842; SYM. Mal. For. Rec. 16 (1943) 172, f. 85, 87, 88. — **Fig. 17A.**

Large pale-barked tree. Twigs, leaf buds, stipule outside, petiole, leaf beneath including nervation, midrib above, calyx, corolla outside and ovary apex densely persistently pale ocheroous-cream puberulent, sometimes fulvous on twigs; fruit calyx glabrescent; leaf bud, stipule and base of inflorescence frequently also densely  $\pm$  caducously long rufous tufted tomentose, the short even indumentum persisting after the tufts drop. *Twig* c. 10 by 8 mm, stout, somewhat compressed, pale brown, sometimes becoming papery flaky. *Bud* to 6 by 1 cm, lanceolate, acute; *stipule* to 20 by 4 cm, lorate, narrowly obtuse. *Leaves* 15–30 by 7.5–18 cm, broadly elliptic to oblong-ovate, thickly coriaceous, cream beneath, prominently persistently plicate; base obtuse; apex obtuse or subretuse; nerves 18–21 pairs, prominent beneath; tertiary nerves very slender, hardly elevated, densely scalariform; *petiole* 5–8.5 cm long, c. 4 mm  $\varnothing$ , long, stout. *Inflorescences* to 28 cm long, to 5 by 3 mm  $\varnothing$  at base, axillary, somewhat compressed, unbranched, bearing to 10 distichous flowers. *Flower bud* to 3.5 by 1 cm, fusiform. *Stamens* 30, exceeding style at anthesis; filaments short, broad, applanate, deltoid; anthers c. 5 times length of filaments, broadly linear-lanceolate, tapering; appendage stoutly acicular, tapering, c.  $\frac{1}{3}$  length of anther. *Ovary* ovoid, small, densely hirsute as also the basal  $\frac{1}{2}$  of the stoutly columnar  $\pm$  capitate style. *Fruit* shortly pedicellate to subsessile; *calyx tube* to 2.5 cm long, to 3.7 cm  $\varnothing$  including the 5 prominent distal tubercles, subglobose, densely verrucose lenticellate; 2 longer lobes to 21 by 5 cm, oblong, narrowly obtuse, abruptly constricted to c. 2 cm wide and revolute at base; 3 shorter lobes to 15 by 15 cm, suborbicular, revolute.

Distr. *Malesia*: Malaya, N. Sumatra (Atjeh, Langkat), Borneo (S.E., from P. Laut to W. and E. Kutei).

Ecol. Lowland forest to 1000 m, on well drained flat or undulating land or hills; frequently common or semigregarious.

Vern. *Këruing gombang*, *k. dadak*, *k. (mara) këluw-ang*, *k. chaier*, *k. babi* (Malaya), *këruing*, *tampudau*, *tampurau*, *kapenkaluang* (Borneo).

**23. *Dipterocarpus elongatus*** KORTH, Kruidk. (1841) 62; WALP. Rep. 5 (1845) 123; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 36; MIQ. Fl. Ind. Bat. 1, 2 (1859) 498; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 83, 85; DC. Prod. 16, 2 (1868) 613; DYER, J. Bot. 12 (1874) 108; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 203; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 32, 40; MERR. En Born. (1921) 398; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 272; Reinwardtia 5 (1961) 473, 474; ASHTON, Gard. Bull. Sing. 20 (1963) 237. — *D. apterus* FOXW. Mal. For. Rec. 10 (1932) 77, pl. 6; BURK, Dict. (1935) 842; SLOOT, Bull. Jard. Bot. Btzig III, 16 (1940) 439, f. 3; SYM. Mal. For. Rec. 16 (1943) 167, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 107; ASHTON, Man. Dipt. Brun. (1964) 23, f. 6; *ibid.* Suppl. (1968) 11. — **Fig. 17F.**

Twigs, leaf bud, stipule outside and petiole with  $\pm$  dense,  $\pm$  caducous, very long red-brown tufted tomentum; glab nervation below more sparsely so or glabrous. *Twigs* to 1.5 cm  $\varnothing$  apically, terete, red-brown, becoming cracked and thinly flaked. *Bud* to 6 by 1.5 cm, falcate, acute, glabrescent or remaining tufted as the stipule expands. *Stipule* to 15 by 2.5 cm, hastate, acute. *Leaves* 28–50 by 13–20 cm, elliptic, coriaceous; base obtuse; apex shortly abruptly acuminate; nerves 25–38 pairs, prominent beneath, the lamina persistently plicately folded between; tertiary nerves distant, scalariform; *petiole* 5–7 cm long, 0.5 cm  $\varnothing$ , stout. *Flowers* unknown. *Raceme* to 12 cm long, terminal or axillary, rigid, rarely branched, red-brown long tufted tomentose. *Fruit calyx tube* to 5 by 5.5 cm, at first tomentose, glabrescent, at first obovoid, becoming globose, with 5 obtuse distal tubercles, constricted to c. 1.5 cm  $\varnothing$  at neck; lobes equal, vestigial, to 8 mm long, becoming recurved, obtuse.

Distr. *Malesia*: Malaya (E. coast: Kelantan to Central and E. Johore and Singapore), eastern Sumatra (Serdang and Langkat Distr.), Lingga Arch., Anambas Is. (S. China Sea), Borneo (Sarawak N.E. of Rejang, Kapuas valley, S.E. Kalimantan).

Ecol. Fresh water swamp, usually on sandy, periodically well drained, soil; locally common in primary and secondary forest.

Vern. *Këruing latek*, *latek*, *k. babi* (Brun.), *k. gumbang* (Mal.), *k. pasir* (Sum.).

Note. Closely allied to the previous two species and differing from *D. humeratus* principally in the fruit.

**24. *Dipterocarpus lamellatus*** HOOK. f. Trans. Linn. Soc. 23 (1860) 159; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 611; WALP. Ann. 7 (1869) 377; DYER, J. Bot. 12 (1874) 107, t. 145, f. 22; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 202; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 256;



BRANDIS, J. Linn. Soc. Bot. 31 (1895) 39; MERR. En. Born. (1921) 399; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 251; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 347; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 261, f. 41.

Large tree. Twigs, leaf buds, stipule, petioles, leaf nervation beneath, midrib above, petiole and inflorescences densely persistently pale yellow-brown hirsute; leaf surfaces and fruit calyx sparsely so. Twig c. 4 mm  $\varnothing$  apically, terete,  $\pm$  rugose. Leaf bud to 9 by 7 mm, ovoid, acute; stipules unknown. Leaves 13–16 by 6–9 cm, elliptic, thinly coriaceous,  $\pm$  boat shaped with the lower surface concave; base narrowly obtuse; acumen to 8 mm long, abrupt, slender; nerves 15–17 pairs, straight, ascending at c. 45°, slender but prominent beneath, shallowly depressed above as also the midrib; tertiary nerves laxly scalariform, slender but prominent beneath, evident above; petiole 3–4 cm long, c. 2 mm  $\varnothing$ , slender. Inflorescence to 6 cm long, axillary, apparently unbranched, bearing to 3 fruit (flower unknown). Fruit pedicel to 4 mm long, slender; calyx tube to 1.8 cm  $\varnothing$  including the 5 densely convoluted wings, subglobose; 2 longer lobes to 14 by 2.5 cm, spatulate, subacute, c. 8 mm broad at base; 3 shorter lobes to 14 by 7 mm, ovate,  $\pm$  revolute.

Distr. *Malesia*: Borneo (Sabah: Labuan (extinct), Beaufort).

Ecol. Rare in Mixed Dipterocarp forest on low hills near coast.

Vern. *Këruing jarang*.

**25. *Dipterocarpus lowii* Hook. f.** Trans. Linn. Soc. 23 (1860) 160; Miq. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 58; DC. Prod. 16, 2 (1868) 613; WALP. Ann. 7 (1869) 377; DYER, J. Bot. 12 (1874) 107, t. 145, f. 23; BURCK. Ann. Jard. Bot. Btzg 6 (1887) 202; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40; MERR. En. Born. (1921) 399; RIDL. Fl. Mal. Pen. Suppl. (1925) 291; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 344, f. 14–15; in Merr. Pl. Elm. Born. (1929) 201; FOXW. Mal. For. Rec. 3 (1927) 43; *ibid.* 10 (1932) 91; SYM. Mal. For. Rec. 16 (1943) 183, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 110; ASHTON, Man. Dipt. Brun. (1964) 37, f. 6, pl. 14 (stem, habit); *ibid.* Suppl. (1968) 15; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 261, f. 3b. — *D. undulatus* VESQUE, C. R. Ac. Sc. Paris 78 (1874) 626; J. Bot. 12 (1874) 151; DYER, J. Bot. 12 (1874) 153. — **Fig. 25.**

Twig, midrib and nerves below  $\pm$  densely  $\pm$  caducously shortly pale golden-yellow pubescent. Twig 2–3 by 5–10 mm  $\varnothing$ , compressed, with broad swollen stipule scars. Leaf bud c. 1.5 by 0.9 cm, broadly conical, frequently falcate, obtuse. Stipule to 4 by 3 cm, broadly deltoid, acute. Leaves 15–20 by 6–10 cm, ovate-lanceolate, thickly coriaceous, strongly folded between the 15–20 pairs of prominent nerves; margin revolute; base obtuse or cordate; apex obtuse or with to 6 mm long narrow acumen; petiole 1.5–3 cm long, stout, often wrinkled on drying. Raceme to 3 cm long, short, stout, terminal or axillary, terete, simple or singly branched, flowers distichous;

bracteoles to 15 by 10 mm, elliptic to ovate, subacute, densely shortly pubescent outside, puberulent within, fugaceous. Flower bud to 4 by 1.2 cm. Calyx densely golden-yellow pubescent, wings prominently undulate. Corolla typical. Stamens c. 30, shorter than the style; filaments short; anthers narrowly oblong; appendage to connective somewhat shorter than anther, stout at base, tapering. Ovary ovoid-conical, tapering, densely pubescent; stylopodium narrowly cylindrical, pubescent, tapering to the somewhat shorter glabrous filiform style. Fruit calyx glabrescent, tube c. 4 cm long and  $\varnothing$  (including wings), globose, completely hidden by the intricate folds of the 5 wings; 2 longer calyx lobes to 14 by 3.5 cm, broadly oblong, obtuse, somewhat revolute, hardly constricted at the base, concurrent with the wings of the tube, with one long median nerve and two shorter laterals; 3 shorter lobes 1.5–2 by 2 cm, broadly ovate, recurved and concurrent with the wings.

Distr. *Malesia*: Malaya (Perak, E. coast), P. Singkep, eastern Sumatra (Kuantan Distr., Langsa, Langkat, Batu Is.), Borneo (Kapas valley, Sarawak to Sabah; Tidung).

Ecol. Well-drained leached, usually sandy soils, in lowlands, especially on islands and near present and former coastlines on low hills to 400 m; locally common on ultrabasics in Sabah.

Vern. *Këruing sol*, *k. hijau*, *k. daun panjang*, *k. batu*, *k. sindor* (Mal.), *bajan* (Sabah), *kawaan kaput* (W. Borneo).

Note. Specimens from Malaya north of Johore and from Sumatra and Singkep bear smaller leaves and more slender twigs and petioles.

**26. *Dipterocarpus pachyphyllus* MEIJER**, Acta Bot. Neerl. 12 (1963) 351, pl. 15; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 265; ASHTON, Man. Dipt. Brun. (1964) 41, f. 6; *ibid.* Suppl. (1968) 16. — **Fig. 17E.**

Freshly opened young parts evenly shortly pale tawny tomentose, fugaceous on all but bud, stipule and raceme. Twig to 4 by 2.5 cm  $\varnothing$  towards apex, compressed, smooth, with prominent raised stipule scars. Bud c. 18 by 4 mm, linear, acute. Stipule to 4 by 1.2 cm, linear to deltoid, subacute. Leaves 9–17 by 5–9 cm, broadly ovate, thickly coriaceous; base obtuse to subcordate; acumen to 1 cm long, broad; nerves 10–12 pairs, distant, prominent, straight but curving abruptly at the margin and coalescing to form an indistinct intramarginal nerve; petiole 2–3.4 cm long, slender, prominently geniculate. Raceme to 5 cm long, terminal or axillary, terete, simple, flowers distichous. Flower bud to 15 by 5 mm. Calyx densely golden-tawny pubescent; wings prominently undulate. Corolla typical. Stamens 23–25, shorter than style; filaments as long as anthers, applanate at base, tapering; anthers narrowly oblong; appendage to connective somewhat shorter than anther, stout at base, tapering. Ovary narrowly ovoid, densely pubescent; stylopodium indistinct, tapering into style; style filiform, glabrous except at base, somewhat shorter than ovary and stylopodium. Fruit calyx entirely glabrous,



Fig. 25. *Dipterocarpus lowii* Hook. f. (2 trees) as emergent in undisturbed profile of lowland dipterocarp forest, near Bt. Puan, Belait, Brunei, c. 20 m alt.; pineapple cultivation in foreground (Photogr. ASHTON, Jan. 1960).



pruinose; tube to 2.5 by 2 cm including wings, subglobose, completely hidden by the intricate folds of the 5 wings; 2 longer lobes to 13 by 3 cm, spatulate, subacute, with one long median nerve and two short laterals; 3 shorter lobes to 1 by 1.5 cm, broadly deltoid, recurved.

Distr. *Malesia*: Northern Borneo (Sabah, Brunei, Sarawak E. of the Lupar).

Ecol. Scattered on leached clay soils in Mixed Dipterocarp forest, undulating land and hillsides to 400 m.

Vern. *Këruing daun tebal, këruing sol padi*.

**27. *Dipterocarpus confertus*** SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 322, f. 9; in Merr. Pl. Elm. Born. (1929) 201; Bull. Bot. Gard. Btżg III, 17 (1941) 104; f. 14; Reinwardtia 5 (1961) 62, f. 1; FOXW. Mal. For. Rec. 10 (1932) 62; BROWNE, For. Trees Sarawak & Brunei (1955) 108; ASHTON, Man. Dipt. Brun. (1964) 26, f. 6; *ibid.* Suppl. (1968) 12; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 242, f. 3a, pl. 26a (stem).

Young twig, leaf bud, stipule outside, petiole, nerves and midrib above, nervation beneath, and inflorescence persistently 1.5–3.5 mm long pale fulvous-brown tufted hispid; leaf surface caducously so. Twig 0.8–1 cm  $\varnothing$  apically, stout, uneven, cracked and marked by the thin amplexicaul stipule scars. Bud 1.2–2 by 1–1.7 cm, broadly ovoid, obtuse or subacute. Stipule to 5 cm long and broad, broadly ovate, obtuse, caducous. Leaves (18–)22–35 by (14–)16–22 cm, broadly obovate to orbicular, chartaceous, concave; base obtuse or subpeltate, the lamina continuing as a slight ridge above the base of the midrib; apex obtuse or shortly acuminate; nerves 9–12 pairs, well spaced, at 45° to 60°; petiole 5–6 cm long. Inflorescence to 7 cm long, subcymose, singly branched or unbranched, short, bearing few distichous flowers; bracts and bracteoles to 25 by 5 mm, linear, obtuse, sparsely tomentose, caducous. Bud to 4 by 1 cm. Calyx and corolla typical, calyx shortly tomentose. Stamens c. 25, as long as style; filaments as long as anther, applanate at base, tapering and filiform below anther; anther narrowly oblong, stout, tapering; appendage almost as long as anther, stout at base, tapering and filiform at apex. Ovary small, ovoid-conical, densely pubescent; stylopodium indistinct; style 3 times as long as ovary, columnar, slender, tomentose except at apex. Fruit subsessile; calyx tube densely pale fulvous long tomentose, c. 3 by 1.7 cm, narrowly obovoid, with 5 indistinct ridges when mature, tapering basally to the pedicel, only slightly constricted apically; 2 long lobes to 14 by 3 cm, glabrous within, sparsely tomentose outside, oblong-lanceolate, obtuse, tapering to the constricted but non-revolute base, prominently 3-nerved; 3 shorter lobes to 1.7 by 0.7 cm, oblong, recurved distally.

Distr. *Malesia*: Borneo (S.E. Borneo, Sabah, Sarawak and Brunei).

Ecol. Mixed Dipterocarp forests below 800 m, sometimes common on low hills and undulating land.

Vern. *Tampudau* (S.E. Borneo), *këruing kobis* (Sabah, Sarawak).

Note. Sterile collections from Singkep could be either this species or *D. concavus*.

**28. *Dipterocarpus dyeri*** PIERRE in Lanessan, Pl. Util. Colon. Fr. (1886) 297; Fl. For. Coch. 3 (1889) t. 216, 217; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 33; PARKER, Ind. For. Rec. 16 (1931) 13; PARKINSON, Burma For. Bull. 27 (1932) 15; FOXW. Mal. For. Rec. 10 (1932) 79, p.p.; BURK. Dict. (1935) 843; SYM. Mal. For. Rec. 16 (1943) 176, f. 85.

Large pale-barked semi-deciduous tree. Leaf buds, stipules outside and ovary apex densely persistently long rufous silky velutinate, twigs, leaf nervation beneath and midrib above, inflorescence and calyx caducously  $\pm$  sparsely so. Twig 10–15 mm  $\varnothing$  apically, stout, pale brown, rugose, lenticellate; internodes short, the leaves densely clustered at the ends of the twigs. Buds to 25 by 15 mm, large, ovoid-lanceolate, acute; stipule to 15 by 2.5 cm, lanceolate, subacute. Leaves 16–40 by 7.5–14 cm, large, narrowly ovate to elliptic, coriaceous; base broadly cuneate to subcordate; acumen to 5 mm long, short, broad, tapering; nerves 24–30 pairs, ascending, slender but prominent beneath as also the midrib; petiole 4–6 cm long, to 4 mm  $\varnothing$ , relatively slender. Inflorescence to 16 cm long, axillary, straight, borne in dense clusters behind the leaves, each bearing to 6 distichous flowers. Flower buds to 5 by 1.3 cm long, fusiform. Stamens c. 30, exceeding style at anthesis; filaments slender, tapering,  $\pm$  equal to the shortly lorate tapering distally fimbriate anthers; appendage acicular, somewhat shorter than anthers; ovary narrowly ovoid, surmounted by a slender columnar style c.  $\frac{1}{2}$  its length. Fruit pedicel to 3 mm long; calyx tube to 4 by 3 cm, ellipsoid, with 5 narrow ribs running from the apex for  $\frac{2}{3}$  its length; 2 longer lobes to 20 by 5.5 cm, oblong-ob lanceolate, obtuse, c. 8 mm wide and somewhat revolute at base; 3 shorter lobes to 15 by 6 mm, ovate, subacute, revolute.

Distr. Cochinchina, Cambodia, S.E. and peninsular Thailand, Mergui, and in *Malesia*: Malaya (Perlis and N. Kedah).

Ecol. Semi-evergreen Dipterocarp forest and *Schima*-bamboo forests at low elevations in the seasonal zone, in moist sandy soil in valleys by streams but not normally alluvium.

Vern. *Këruing daun besar, k. etoi* (Malaya).

Note. PARKER observed hybridisation between this species and *D. alatus* ROXB. in peninsular Burma.

**29. *Dipterocarpus fagineus*** VESQUE, C. R. Ac. Sc. Paris 78 (March 1874) 625; J. Bot. 12 (1874) 149; DYER, J. Bot. 12 (1874) 152; BURCK, Ann. Jard. Bot. Btżg 6 (1887) 200; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 94, p.p.; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 33; BURK. J. Str. Br. R. As. Soc. 81 (1920) 51, 53, fig.; MERR. En. Born. (1921) 398; RIDL. Fl. Mal. Pen. 1 (1922) 216, p.p.; SLOOT. Bull. Jard. Bot. Btżg III, 8 (1927) 318; FOXW. Mal. For. Rec. 10 (1932) 80; SYM.

Kew Bull. (1937) 318; Mal. For. Rec. 16 (1943) 177, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 108; ASHTON, Man. Dipt. Brun. Suppl. (1968) 14, f. 2; Gard. Bull. Sing. 31 (1978) 10. — *D. prismaticus* DYER, J. Bot. 12 (Apr. 1874) 104, t. 144, f. 17; *ibid.* (May 1874) 152. — *Duvaliella problematica* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 1009; Rech. Dipt. (1892) 72; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 263; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 258. — *D. pseudofagineus* FOXW. Mal. For. Rec. 10 (1932) 82; SYM. Mal. For. Rec. 16 (1943) 186, f. 85.

Young twigs, leaf buds, stipule outside (glabrous within) and petiole shortly evenly densely persistently pale golden-brown pubescent, occasionally glabrous; midrib on both surfaces sparsely so. *Twigs* c. 2 mm  $\varnothing$  near the apices, ribbed, smooth to rugulose. *Bud* to 10 by 2.5 mm, falcate, acute. *Stipule* to 20 by 3 mm, linear, caducous, sparsely pubescent outside, glabrescent within. *Leaf* 4–9(–12) by 1.5–4.0(–5.5) cm, narrowly elliptic to lanceolate; frequently glaucous beneath; base cuneate; acumen to 8 mm long, slender; nerves 8–10(–16) pairs, slender but elevated beneath, at 30°–40°; tertiary nerves slender, subscalariform; midrib appanate above, prominently terete beneath; *petiole* 11–17 mm long, slender, geniculate, drying buff pubescent. *Raceme* to 5 cm long, caducously shortly evenly golden-buff pubescent, unbranched or sometimes finely branched, bearing to 4 flowers. *Flower bud* to 20 by 6 mm, fusiform. *Calyx* glabrescent. *Corolla* densely golden-buff pubescent outside, sparsely so within. *Stamens* 15, shorter than style at anthesis; filaments slender, tapering, c.  $\frac{1}{3}$  length of anther. *Gynoecium* cinereous but for the distal  $\frac{1}{3}$  of the style; ovary ovoid; style broadly columnar, somewhat tapering. *Fruit calyx* and *pedicel* glabrous. *Pedicel* to 6 mm long. *Calyx tube* to 10 by 8 mm, subglobose to ellipsoid, decurrent with pedicel at base, with 5 slender acute ribs continuous to base or confined to distal end; 2 longer lobes to c. 8(–20) by 1.5 cm, lorate, obtuse; 2 shorter lobes to 6 by 5 mm, deltoid, subacute. *Nut apex* densely golden-buff pubescent; style remnant 10 mm long, slender, pubescent.

Distr. *Malesia*: Malaya (Perak, Penang, coastal Pahang and Trengganu), N.E. Sumatra (Riouw-Lingga), Borneo (Sarawak).

Ecol. Hill forests, locally gregarious on ridges, especially at 500–800 m but down to 100 m near coast.

Vern. *Kěruing pipit* (Mal.).

Note. Collections from low altitude, previously described as *D. pseudofagineus* generally, have longer leaves with more nerves, are generally glaucous beneath, and have fruit calyx ribs confined to the distal half. There is no discontinuity in the variation between the lowland and hill forms however and these species are therefore not regarded as distinct here.

**30. *Dipterocarpus cinereus*** SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 319, f. 8.

Large tree. Twig, leaf bud, stipule, petiole, leaf undersurface, panicle and ovary densely persistently

buff pubescent; hairs longer on buds and stipules; calyx thus at first, becoming sparsely so in fruit; parts of petals exposed in bud densely puberulent. *Twigs* c. 2 mm  $\varnothing$  apically, terete, rugulose, pale brown, much branched. *Buds* to 12 by 3 mm, lanceolate-falcate; expanded *stipule* not seen. *Leaves* 6–8 by 1.7–2.5 cm, lanceolate, thinly coriaceous, distinctly persistently plicate; base cuneate; apex shortly narrowly tapering-acuminate; nerves 8–9 pairs, steeply ascending at c. 40°, slender but distinctly elevated beneath; tertiary nerves densely scalariform, slender and obscure; midrib prominent beneath, shallowly depressed above; *petiole* 1.7–2.5 cm long, very slender. *Inflorescence* to 4 cm long, axillary, simple or singly branched, bearing 4–5 secund flowers. *Flower buds* to 22 by 8 mm, fusiform. *Stamens* c. 25, exceeding style at anthesis; filaments slender, somewhat longer than the narrow tapering anthers and appendage; *style* columnar, pubescent in the basal  $\frac{1}{2}$ . *Fruit pedicel* to 3 mm long, broadening into the to 14 by 10 mm broadly ellipsoid or obovoid, sharply though narrowly 5-ribbed, calyx tube; 2 longer lobes to 5 by 1.2 cm, broadly spatulate, narrowly obtuse, constricted to c. 4 mm broad at base; 3 shorter lobes to 5 by 5 mm, ovate, obtuse,  $\pm$  revolute.

Distr. *Malesia*: Central W. Sumatra (P. Musala).

Ecol. Lowland forest on leached soils, rather common.

Vern. *Lagan bras*.

Note. Clearly closely allied to *D. fagineus*, from which it differs principally in the number of stamens.

**31. *Dipterocarpus semivestitus*** SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 342, f. 13; SYM. Mal. For. Rec. 16 (1943) 188, f. 85.

Parts glabrous but for densely puberulent inflorescence, fruit calyx tube, sparsely puberulent fruit calyx lobes, and densely pubescent ovary. *Twig* c. 3 by 2 mm,  $\pm$  compressed apically, slender, much branched, blackish, minutely pale lenticellate; stipule scars oblique. *Buds* to 8 by 2 mm, lanceolate-falcate, slender, drying black; *stipules* unknown. *Leaves* 5.6–11 by 2.5–6 cm, narrowly elliptic, coriaceous; margin somewhat undulate; base cuneate; acumen to 1 cm long, slender; nerves 6–8 pairs, steeply ascending, slender and hardly elevated beneath; tertiary nerves densely scalariform, hardly elevated beneath, set vertically to the midrib; *petiole* 1.4–2.2 cm long, slender. *Inflorescence* to 7 cm long, simple. *Flower* unknown. *Fruit* subsessile; *calyx tube* to 15 by 10 mm, narrowly obovoid, with 5 sharp undulating ridges or narrow, to 2 mm wide, wings; 2 longer lobes to 6.5 by 1.5 cm, spatulate, obtuse, c. 5 mm broad at base; 3 shorter lobes to 5 by 4 mm, elliptic, subrevolute.

Distr. *Malesia*: S. E. Borneo (Marabahan District), Malaya (Perak).

Ecol. Rare in lowland forest on low lying, perhaps almost swampy, land.

Vern. *Kěruing padi*, *k. dadeh* (Malaya), *murtulang* (Borneo).





Fig. 26. The narrow-leaved seedlings of *Dipterocarpus oblongifolius* BL. Brunei (Photogr. ASHTON).

**32. *Dipterocarpus oblongifolius* BL.** Mus. Bot. Lugd.-Bat. 2 (1852) 36; WALP. Ann. 4 (1857) 335; MIQ. Fl. Ind. Bat. 1, 2 (1859) 498; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 614; DYER, J. Bot. 12 (1874) 105; *ibid.* (1874) 152; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 201; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 95; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37; MERR. En. Born. (1921) 399; RIDL. Fl. Mal. Pen. 1 (1922) 216; CRAIB, Fl. Siam. Enum. 1 (1925) 136; ENDERT, Bot. Versl. M.O. Borneo Exp. (1927) 248; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 338; Trop. Natuur 17 (1928) 146, f. 9-10; FOXW. Mal. For. Rec. 10 (1932) 86; BURK. Dict. (1935) 844; CORNER, Wayside Trees (1940) 211; SYM. Mal. For. Rec. 16 (1943) 184, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 110; ASHTON, Man. Dipt. Brun. (1964) 39, f. 6, pl. 9 (seedlings); *ibid.* Suppl. (1968) 16; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 264; SRIVASTAVA, Mal. For. 40 (1977) 251, f. 1; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 44. — *D. stenopterus* VESQUE, C. R. Ac. Sc. Paris 78 (1844) 625; J. Bot. 12 (1874) 150; DYER, J. Bot. 12 (1874) 152. — *D. pulcherrimus* RIDL. Trans. Linn. Soc. Bot. 3 (1893) 283. — **Fig. 26.**

Twig, leaf bud, midrib on both surfaces, nervation beneath, petiole, and raceme densely  $\pm$  evenly caducous pale yellow tomentose; persistently so on stipule outside, calyx and ovary. *Twig* 2-3 mm  $\varnothing$  apically, terete or  $\pm$  compressed; amplexicaul stipule scars inconspicuous. *Bud* c. 20 by 3 mm, linear, compressed, acute. *Stipule* 10-15 by 1.5 cm, linear, obtuse. *Leaves* 14-18(-25) by 4-7(-9) cm, narrowly elliptic to lanceolate; base cuneate; apex gradually tapering; acumen to 1 cm long, slender; nerves 16-20 pairs, slender, at  $40^{\circ}$ - $50^{\circ}$ ; *petiole*  $1\frac{3}{4}$ -2 cm long. *Racemes* to 18 cm long, terminal and axillary, simple or singly branched, with distichous flowers; *bracts* to 20 by 2.5 mm, linear.

*Calyx* densely cream tomentose. *Stamens* 15, shorter than style; anther as long as the filament, narrowly oblong, tapering from the base into the glabrous stout appendage;  $\pm$  shorter than anther; *ovary* conical, densely tomentose, tapering into the stylopodium, the latter twice as long as the ovary, narrowly-cylindrical, tapering into and  $\pm$  twice as long as the filiform glabrous style. *Fruit pedicel* 1-2 mm long. *Fruit calyx* tube 25-30 by 7-9 mm, narrowly obovoid or fusiform, only slightly constricted at the c. 6 mm  $\varnothing$  neck, with 5 wavy, c. 1 mm wide, thin wings from neck to base; 2 longer lobes 10-12 by  $1\frac{1}{2}$  cm, narrowly spatulate, obtuse. 3-4 mm wide at base, 1-nerved with 2 small lateral nerves at the base; 3 shorter lobes c. 10 by 3 mm, narrowly deltoid to linear, obtuse, recurved. *Saplings* stenophyllous.

Distr. S. Peninsular Thailand (Pattani) and in *Malesia*: Malaya (all major east-flowing rivers; rare in Perak), Borneo (excepting most of Sabah).

Ecol. Gregarious on the banks of fast-flowing inland rivers, germinating and becoming established below the flood-line.

Vern. *Neram* (Mal.), *laran* (S.E. Borneo), *ensurai*, *gansurai* (northern Borneo).

Note. Leaves of seedlings are linear-lanceolate; cf. VAN SLOOTEN (1928) and SRIVASTAVA (1977). This species is so characteristic of swift-running streams in Borneo and Malaya, that CORNER (1940, 1978) gave the name *neram* rivers to this type.

**33. *Dipterocarpus grandiflorus* (BLCO) BLCO, Fl. Filip.** ed. 2 (1845) 314; *ibid.* ed. 3, 2 (1878) 218, t. 263; DC. Prod. 16, 2 (1868) 612; DYER, J. Bot. 12 (1874) 106, t. 145, f. 19; VIDAL, Sinopsis (1883) t. 14A; Pl. Vasc. Filip. (1886) 59; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 201; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 95; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 256; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37; RIDL. Agr. Bull. Str. & F. M. S. 1 (1901) 55; Fl. Mal. Pen. 1 (1922) 216; FOXW. Philip J. Sc. 6 (1911) Bot. 251, pl. 36; *ibid.* 13 (1918) Bot. 179; *ibid.* 67 (1938) 259; Mal. For. Rec. 10 (1932) 87; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 273; *ibid.* ed. 2 (1927) 1095, 1096; MERR. Sp. Blanc. (1918) 268; En. Born. (1921) 398; En. Philip. 3 (1923) 89; BURK. J. Str. Br. R. As. Soc. 81 (1920) 55; REYES, Philip. J. Sc. 22 (1923) 321; CRAIB, Fl. Siam. Enum. 1 (1925) 134; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 25; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 333; PARKER, Ind. For. Rec. 16 (1931) 5; PARKINSON, Burma For. Bull. 27 (1932) 17; BURK. Dict. (1935) 843; SYM. Mal. For. Rec. 16 (1943) 178, f. 85, 90; SMITINAND, Thai For. Bull. 4 (1958) 33; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 252, f. 38. — *Mocanera grandiflora* BLCO, Fl. Filip. ed. 1 (1837) 451. — *D. blancoi* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 35. — *Vatica trigyna* GRIFF. Notul. 4 (1854) 514. — *D. motleyanus* HOOK f. Trans. Linn. Soc. 23 (1860) 159; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 611; WALP. Ann. 7 (1869) 377. — *D. griffithii* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 213; DC. Prod. 16, 2 (1868) 612; WALP. Ann. 7

(1869) 377; DYER, Fl. Br. Ind. 1 (1874) 299; J. Bot. 12 (1874) 107; KURZ, Fl. Burma 1 (1877) 116; RIDL. Trans. Linn. Soc. Bot. 3 (1893) 283; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 96; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37; Ind. Trees (1906) 701; GAMBLE, Man. Ind. Timb. (1922) 70. — *D. pterygocalyx* SCHEFF. Nat. Tijd. N. I. 31 (1870) 347; DYER, Fl. Br. Ind. 1 (1874) 298; HEYNE, Nutt. Pl. ed. 2 (1927) 1096. — **Fig. 17B.**

Very large hardly buttressed tree. Leaf bud, outside of stipule, parts of petals exposed in bud, ovary apex and sometimes twig densely evenly pale buff pubescent, parts otherwise glabrous. *Twigs* to 12 mm  $\varnothing$ , stout, becoming grey-brown; internodes short, the leaves clustered around the twig endings. *Buds* to 2 by 1 cm, ovoid, acute; *stipule* to 18 by 5 cm, oblong-lanceolate, subacute. *Leaves* 10–18 by 5–12 cm, ovate, coriaceous,  $\pm$  applanate; base obtuse or subcordate; acumen to 1 cm long, short, nerves 15–17 pairs, prominent beneath, spreading; tertiary nerves remotely scalariform, barely elevated; *petioles* 3–9 cm long, very long, slender. *Inflorescences* to 18 cm long, very long, slender, axillary, borne in dense groups behind the leaves, unbranched, bearing to 3 remote distichous flowers. *Flower buds* to 3.5 by 1.3 mm, fusiform. *Stamens* 30, exceeding style at anthesis; filaments broad, compressed, tapering, *c.*  $\frac{1}{3}$  the length of the relatively short broadly linear-lanceolate tapering anthers; appendages acicular, *c.*  $\frac{2}{3}$  length of anthers. *Ovary* tapering into the short stoutly columnar style; ovary and style puberulent in the basal half. *Fruit pedicel* to 2 by 4 mm, stout. *Calyx tube* to 7 by 3.5 cm, ellipsoid, with 5 pruinose, to 1.5 cm wide, prominent coriaceous wings continuous from base to apex; 2 longer lobes to 2.2 by 3 cm, oblanceolate-spattulate, obtuse, tapering abruptly to *c.* 1.3 cm wide at base; 3 shorter lobes to 2 by 1.5 cm, elliptic, subrevolute.

Distr. Andamans, Mergui, Peninsular Thailand, and in *Malesia*: Malaya, north-east Sumatra (Atjeh, Langkat, Bengkalis, P. Simalur, P. Musala, Riau Arch., Banka, Billiton), P. Karimata, Borneo (from lower Dayak in S.W. to Sabah in E.; incorrectly recorded by BROWNE, For. Trees Sarawak & Brunei (1955) 106 from Sarawak), Philippines (N.W. Luzon).

Ecol. Often common, becoming semi-gregarious, in more seasonal climates in Semi-evergreen Dipterocarp forests; on small islands and on coastal hills in less seasonal areas, and in Malaya occurring frequently with *Shorea curtisii* on inland ridges to 700 m.

Vern. *Këruing bëlimbing*, *k. pekat*, *meluit* (Malaya), *këruing*, *lagan bras* (Sumatra), *tampudau*, *bajan*, *këruing* (Borneo), *apitong* (Tag.).

Note. A remarkable relic from the once vast Semi-evergreen Dipterocarp forests of the Pleistocene Sundaland.

**34. *Dipterocarpus glabrigemmatu*** ASHTON, Gard. Bull. Sing. 31 (1978) 11. — *D. sp.* ASHTON, Man. Dipt. Brun. Suppl. (1968) 19.

Midrib and nerves sparsely pubescent, other vege-

tative parts glabrous. *Twig c.* 3 by 2 mm  $\varnothing$  apically, somewhat compressed and ribbed, lustrous; stipule scars slender, pale, hardly raised. *Leaf bud* to 6 by 4 mm, acute. *Stipule* unknown. *Leaves* 6–9 by 4.5–6 cm; broadly ovate; margin sinuate distally; base obtuse; acumen to 5 mm long, short, broad; nerves 10–11 pairs, prominent beneath, at 45°–60° near the base, straight but curving near the margin; midrib applanate above, prominently terete beneath; tertiary nerves subscalariform; *petiole* 1.5–2.5 cm long, slender, drying rugose. *Raceme* to 10 cm long, to 1 mm  $\varnothing$  at base, axillary, unbranched, glabrous. *Flower bud* to 2.5 by 12 mm. *Calyx* glabrous, prominently 5-winged; *corolla* typical. *Stamens* 15, subequal; filaments compressed at base, tapering; anthers linear, 2–3 times as long as filaments; appendage to connective almost as long as anther, filiform, tapering. *Ovary* ovoid, small, pubescent; style *c.* 5 times length of ovary, pubescent except at apex. *Fruit* unknown.

Distr. *Malesia*: Borneo (Central Sarawak).

Ecol. Local, Mixed Dipterocarp forest, clay soil.

**35. *Dipterocarpus palembanicu*** SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 336, f. 12; SYM. Mal. For. Rec. 16 (1943) 185, f. 85; ASHTON, Man. Dipt. Brun. Suppl. (1968) 16, f. 6–7, pl. 6 (stem), *p.p.*; Gard. Bull. Sing. 31 (1978) 11. — *D. alatus* (non ROXB.) FOXW. Mal. For. Rec. 10 (1932) 82.

**a. *ssp. palembanicu*.**

Twig, leaf bud and stipule outside densely fulvous hirsute; petiole midrib above and leaf beneath densely shortly puberulent; caducous on twigs and petioles, otherwise persistent. *Twig* 2–3 mm  $\varnothing$ , terete, with a rather papery, finely cracked surface. *Bud* 4–12 by 3–4 mm, shortly oblong to conical, obtuse. *Stipule* 2–3 cm long, narrowly hastate, acute. *Leaves* 10–14 by 5–9 cm, broadly elliptic to ovate, thinly coriaceous; base obtuse or cuneate, acumen short or to 2 cm long, narrow; margin undulate; nerves slender, dense, 12–14 pairs, at 35°–45°, tending to be persistently plicately folded between; tertiary nerves densely scalariform, slender; *petiole* 2–3 cm long, prominently geniculate. *Raceme* to 6 cm long, terminal or axillary, terete, tending to wrinkle on drying, unbranched or singly branched, the branchlets bearing distichous flowers. *Bud* to 3.5 by 1.5 cm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* 15; filaments compressed at base, slender, tapering; anthers linear, *c.*  $\frac{1}{2}$  length of filament, tapering apically; appendage to connective *c.*  $\frac{1}{2}$  length of anther, filiform, tapering, reaching to  $\frac{1}{2}$  length of style. *Ovary* ovoid, densely pubescent, tapering into style; style 3–4 times length of ovary, stoutly filiform, densely pubescent and ribbed in the basal  $\frac{2}{3}$ , otherwise glabrous. *Fruit calyx* glabrous; tube to 3.5 by 1.5 cm, narrowly ellipsoid, tapering gradually to the base and the *c.* 1 cm  $\varnothing$  neck; broadly 5-winged, the wings thin, to 8 mm broad,  $\pm$  obtuse or subcordate at base, with the margin folded over frequently at maturity; 2 longer calyx lobes to 10 by 3.5 cm, oblong, obtuse, base revolute, subcordate,



with 3 parallel nerves running down the whole length close to the centre; 3 shorter calyx lobes to 5 by 10 mm, broadly orbicular, strongly recurved, with narrow base and revolute undulate margin.

Distr. *Malesia*: Malaya (Trengganu, Central Johore), Singapore, Sumatra (Palembang), Borneo (Central Sarawak).

Ecol. Local, Mixed Dipterocarp forest on hills, clay soils, to 650 m.

Vern. *Këruing ternek* (Mal.), *lagan daun halus* (Sum.).

**b. *ssp. borneensis*** ASHTON, Gard. Bull. Sing. 31 (1978) 11. — *D. palembanicus*: ASHTON, Man. Dipt. Brun. (1964) 41; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 266, f. 42.

Differing from *ssp. palembanicus* as follows: Twig, petiole, midrib (both surfaces) and nerves beneath densely shortly chestnut pubescent, caducous on twigs; persistent, long, on bud, stipule and petiole; lamina fugaceous pubescent. *Leaves* 7–11 by 3–6 cm, oblong to ovate, with 12–14 pairs of nerves; *petiole* c. 15 mm long. *Fruit calyx tube* to 5.5 by 2 cm, wings to 15 mm broad, undulate, auriculate at base and apex.

Distr. *Malesia*: northern Borneo (Central and N.E. Sarawak to E. Sabah and Nunukan I.).

Ecol. As *ssp. palembanicus*, and sometimes growing together with it.

**36. *Dipterocarpus fusiformis*** ASHTON, Gard. Bull. Sing. 31 (1978) 12.

Large tree. Young parts densely buff velutinate, persistent on leaf bud and stipule outside, becoming sparse yet  $\pm$  persistent on twigs, petiole and leaf undersurface, elsewhere caducous. *Twigs* c. 2 mm  $\varnothing$  apically, slender, terete,  $\pm$  verrucose. *Buds* to 15 by 3 mm, linear, lanceolate; *stipule* to 30 by 6 mm, lanceolate, acute. *Leaves* 7–17 by 3–7 cm, elliptic or narrowly ovate, coriaceous; base cuneate or obtuse; acumen to 12 mm long, slender, prominent; nerves 13–17 pairs, slender but prominent beneath, ascending at 30°–40°; tertiary nerves densely scalariform, evident but hardly elevated beneath; *petiole* 2–2.6 cm long, slender. Complete inflorescences unknown; *in-florescences* singly branched or unbranched, axillary. *Flowers* unknown. *Fruit pedicel* c. 1 mm long, short; *calyx tube* to 28 by 18 mm, ellipsoid, with 5, to 6 mm broad, straight incrassate wings or narrow ridges, continuous from base to apex but generally broader in the distal half; 2 longer lobes to 10 by 2.6 cm, broadly spatulate, obtuse, c. 7 mm wide at base; 3 shorter lobes to 5 by 5 mm, suborbicular, subrevolute.

Distr. *Malesia*: N.E. Borneo (Tawau area).

Ecol. Undulating well drained fertile soils; Mixed Dipterocarp forest; rare.

Note. Clearly closely allied to *D. mundus* SLOOT. of the Central Bornean hills, a species which is conspicuously glabrous but for its corolla, ovary, and the inside of its stipules. The two species are therefore very different in appearance; flowers are still awaited and may provide further differences.

**37. *Dipterocarpus mundus*** SLOOT. Bull. Jard. Bot. Btzig III, 16 (1940) 446, f. 7; ASHTON, Man. Dipt. Brun. Suppl. (1968) 15, f. 3. — Fig. 17G.

Parts glabrous but for pubescent inner surface of stipules. *Twig* c. 2–3 mm  $\varnothing$  apically, terete, much branched; stipule scars slender, elevated but not prominent. *Bud* to 14 by 3 mm, slender, acute. *Stipule* to 4.0 by 0.6 cm, linear, caducous. *Leaves* 5.5–16 by 2.5–7.5 cm, narrowly elliptic to obovate; base narrowly obtuse; acumen to 8 mm long; nerves 8–10 pairs, straight, slender but prominent beneath, at 30° to 50°; tertiary nerves remotely subscalariform; midrib  $\pm$  applanate above, stout, prominent, terete beneath; *petiole* 1.6–3 cm long, slender, geniculate. *Raceme* to 6 cm long, terete to somewhat compressed, smooth, unbranched, bearing to 4 flowers. *Flower calyx* and *corolla* typical. *Stamens* 15; filaments short, compressed, anthers narrowly oblong; appendage to connective c.  $\frac{1}{2}$  length of anthers, filiform, tapering. *Ovary* small, ovoid; stylopodium columnar, tapering, pubescent, ending in a short glabrous style. *Fruit calyx* and *pedicel* glabrous. *Pedicel* to 3 mm long, c. 1 mm  $\varnothing$ . *Calyx tube* to 3 by 1.2 cm, fusiform, bearing 5 wings, each to 7 mm wide, broadest in the distal half, incrassate; 2 longer lobes to 11 by 2.7 cm, oblong, tapering to an obtuse apex, c. 5 mm broad above the tube; 3 shorter lobes to 8 by 8 mm, broadly ovoid, obtuse, somewhat recurved. *Nut* narrowly ovoid, densely buff pubescent; style remnant to 8 mm long, filiform.

Distr. *Malesia*: Central Borneo (Kapas, Rejang hinterland).

Ecol. Locally frequent on ridges, 400–600 m.

Vern. *Kësural bukit*.

**38. *Dipterocarpus borneensis*** SLOOT. Bull. Jard. Bot. Btzig III, 16 (1940) 445, f. 6; BROWNE, For. Trees Sarawak & Brunei (1955) 107; ASHTON, Man. Dipt. Brun. (1964) 24, f. 6, 7; *ibid.* Suppl. (1968) 11.

Young twig, petiole, raceme, midrib, nerves and sometimes tertiary nerves beneath sparsely shortly rust pubescent, mostly caducous; leaf bud and stipule outside densely persistently so, the hairs longer, pinkish buff. *Twig* 3–5 mm  $\varnothing$  apically, glabrous, smooth but for the paler amplexicaul stipule scars, occasionally rugulose. *Bud* 5–7 by 2.5–3 mm, ovoid, subacute. *Stipule* to 40 by 4–5 mm, linear, acute. *Leaves* 7–12 by 3–7 cm, broadly ovate to elliptic; base obtuse or broadly cuneate; acumen to 8 mm long; nerves 9–12 pairs, distant, at 50° at the lamina base, down to 20° at the apex, prominent; margin frequently undulate towards the apex; *petiole* 1.5–2.5 cm long, slender. *Raceme* to 6 cm long, singly or rarely doubly branched, terminal or axillary, terete or  $\pm$  compressed; *bracteoles* unknown. *Flower bud* to 4 by 1 cm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* c. 25, shorter than the style; anthers short, narrowly sagittate; appendage stout, tapering, c.  $\frac{1}{2}$  length of anther. *Ovary* conical, shortly densely pubescent; stylopodium and style c. 3 times length of ovary, densely tomentose except at apex, slightly

swollen medially. *Fruit calyx tube* to 1.5 by 1 cm, narrowly ovoid to ellipsoid, tapering gradually into the pedicel and to the c. 8 mm  $\varnothing$  neck, with 5 narrow c. 1 mm broad, c. 6 mm, long wings in the distal half terminating at the insertion of the calyx lobes; 2 longer lobes to 7.5 by 1.5–1.8 cm, chartaceous, oblong, obtuse,  $\pm$  abruptly constricted at the undulate margined base; 3 shorter calyx lobes c. 5 by 4 mm, revolute and recurved outwards.

Distr. *Malesia*: Eastern coastal Sumatra (Indragiri; Lingga Arch.: Singkep); Borneo (Sampit to Muara Tewe and Ulu Mahakam in S.E. Borneo; Sambas and Mampawah in W. Borneo; Sarawak and Brunei).

Ecol. Common in heath forest on podsols below 350 m; rare in mixed swamp forest.

Vern. *Lagan*, *këruing daun halus* (Sum.), *ompal*, *pëndërawan*, *awang buah*, *bëngkajarap*, *këruing sindor* (Borneo).

Note. Closely resembling *D. fagineus* but with the ridges of the calyx tube distinctly expanded into narrow wings distally, and with longer tomentum persisting on the nervation beneath.

**39. *Dipterocarpus nudus*** VESQUE, C. R. Ac. Sc. Paris 78 (March 1874) 626; J. Bot. 12 (1874) 150; DYER, J. Bot. 12 (1874) 152; BURCK, Ann. Jard. Bot. Btżg 6 (1887) 201; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 38; MERR. En. Born. (1921) 399; SLOOT, Bull. Jard. Bot. Btżg III, 8 (1927) 325; BROWNE, For. Trees Sarawak & Brunei (1955) 110; ASHTON, Man. Dipt. Brun. (1964) 38, f. 6, 7; *ibid.* Suppl. (1968) 16. — *D. pentapterus* DYER, J. Bot. 12 (Apr. 1874) 106, t. 144, f. 18; *ibid.* (1874) 152.

Glabrous but for the buff pubescent inside of stipules. *Twig* 3–4 mm  $\varnothing$  apically, slender, smooth, often tending to be triangular; with inconspicuous stipule scars. *Bud* 15–30 by 2–3 mm, linear, terete. *Stipule* to 6 by 0.5 mm, linear. *Leaves* 11–14 by 4–6 cm, narrowly elliptic, thinly coriaceous, margin undulate and  $\pm$  sinuate distally; base cuneate, apex to 6 mm long, acuminate; nerves 11–14 pairs, close, oblique (30°–40°); tertiary nerves widely spaced, scalariform but rather sinuate, at c. 90° to nerves; *petiole* 2–4.5 cm long, slender. *Raceme* to 18 cm long, terminal or axillary, glabrous, terete, becoming ribbed on drying, zigzag; simple or singly branched, with distichous flowers at wide intervals; *bracts* unknown. *Flower bud* to 4 by 0.9 cm, slender. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* c. 15, shorter than the style; filaments short; anthers narrowly oblong, tapering. *Ovary* ovoid-conical, densely tomentose; style and stylopodium about 3 times as long as ovary, filiform, slightly tapering, densely tomentose at base, glabrous at apex. *Fruit* glabrous; *calyx tube* c. 2.5 by 1 cm, ellipsoid to fusiform, broadest distally, the base constricted abruptly at the pedicel, slightly constricted at the c. 7 mm  $\varnothing$  neck; 5 winged, the wings incrassate but acute, rather narrow and widest (c. 3 mm) distally, continuing the whole length of the tube; 2 longer calyx lobes to 9.5 by 3 cm, lanceolate, equally 3-nerved,

obtuse, tapering gradually to the 3–4 mm wide base; 3 shorter lobes c. 4 mm long and broad, small, obtuse, slightly revolute.

Distr. *Malesia*: N.W. Borneo (Sarawak and Brunei).

Ecol. Hillsides and ridges in Mixed Dipterocarp forest to 650 m.

Vern. *Këruing lichin*.

**40. *Dipterocarpus geniculatus*** VESQUE, C. R. Ac. Sc. Paris 78 (March 1874) 626; J. Bot. 12 (1874) 150; DYER, J. Bot. 12 (1874) 152; BURCK, Ann. Jard. Bot. Btżg 6 (1887) 199; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 33; MERR. En. Born. (1921) 398; SLOOT, Bull. Jard. Bot. Btżg III, 9 (1927) 317; *ibid.* III, 17 (1941) 99, f. 11; BROWNE, For. Trees Sarawak & Brunei (1955) 109; ASHTON, Man. Dipt. Brun. Suppl. (1968) 14. — *D. angulatus* DYER, J. Bot. 12 (April 1874) 104; *ibid.* (May 1874) 152.

**a. *ssp. geniculatus*.**

Young twig, leaf bud, stipule outside and raceme densely shortly pale cream tomentose; petiole and nervation beneath sparsely pubescent to glabrescent. *Twigs* to 7 mm  $\varnothing$ , with rows of large longitudinally elongated flat lenticels and conspicuous sinuate amplexicaul stipule scars. *Bud* c. 2.5 by 2 cm, broadly ovoid, acute. *Stipule* c. 6 by 2 cm, pink with a cream tomentum when fresh, broadly lanceolate, acute. *Leaves* 7–12 by 5–7 cm, elliptic to  $\pm$  obovate, coriaceous, lustrous above; base obtuse, apex obtuse or shortly acuminate; nerves 10–12 pairs, prominent beneath, well spaced, at 45°–55°; *petiole* stout, straight, 3–5 cm long. *Raceme* to 24 cm long, axillary, terete, straight, singly, rarely doubly branched, the flowers distant, distichous; *bracts* to 20 by 5 mm, narrowly lanceolate, acute, shortly pubescent outside, puberulent within. *Flower bud* to 3.5 by 1 cm. *Calyx* and *corolla* typical, calyx shortly densely cream tomentose. *Stamens* 30, shorter than the style; filaments as long as the anthers; anther rather short, narrowly oblong, tapering apically; appendage to connective somewhat shorter than anther, stout at base, tapering. *Ovary* ovoid-conical, shortly tomentose; style and stylopodium  $\pm$  twice as long as ovary, narrowly cylindrical, shortly tomentose basally, glabrous in the distal  $\frac{1}{2}$ . *Fruit calyx tube* shortly densely cream powdery tomentose, lobes sparsely so; tube c. 1.5 cm long and broad, obovoid, tapering to pedicel and constricted to 1.2 cm  $\varnothing$  at the neck; 5-ridged, the ridges 1 mm thick, stout, to 3 mm wide at the undulate distal ends, continuing from the neck to the pedicel; 2 longer calyx lobes to 12 by 2.5 cm, oblong, obtuse, tapering to the 6 mm broad strongly revolute base with one branching central nerve running to the apex and 2 shorter laterals; 3 shorter lobes c. 1 by 1.5 cm, cordate, the sides recurved.

Distr. *Malesia*: Borneo (Sarawak from the Kemena valley westwards, Lower Kapuas).

Ecol. Lowland dipterocarp forests on leached clay soils, to 400 m.



Vern. *Këruing kërubong*, *k. guntang*, *k. bëlimbang* (Mal.).

**b. ssp. grandis** ASHTON, Gard. Bull. Sing. 20 (1963) 240; Man. Dipt. Brun. Suppl. (1968) 14. — *D. geniculatus* *sensu* ASHTON, Man. Dipt. Brun. (1964) 11, f. 6, pl. 11 (habit, bark); MEIJER & WOOD, Sabah For. Rec. 5 (1964) 248, f. 36.

Differing from *ssp. geniculatus* as follows: Twigs to 13 mm  $\varnothing$ ; leaves 20–35 by 12–16 cm, petiole 8–10 cm long; 2 longer fruit calyx lobes to 15 by 4 cm.

Distr. *Malesia*: N.E. Borneo (Sarawak from Sibuti north-eastwards, Brunei, S.W. Sabah and Sandakan Distr.).

Ecol. As *ssp. geniculatus*, but confined to ultrabasic rocks in E. Sabah.

Vern. *Këruing kërubong*, *k. tangkai panjang*.

**41. Dipterocarpus costatus** GAERTN. f. Fruct. 3 (1805) 50, t. 187; ROXB. Hort. Beng. (1814) 42; Fl. Ind. ed. Carey 2 (1832) 613; BUCH.-HAM. Mem. Wern. Nat. Hist. Soc. 6 (1832) 299; WALP. Rep. 5 (1945) 124; DC. Prod. 16, 2 (1868) 610; KURZ, J. As. Soc. Beng. 43, 2 (1874) 98; Fl. Burma (1877) 117; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 98; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 35; Ind. Trees (1906) 66; GAMBLE, Man. Ind. Timb. (1922) 70; CRAIB, Fl. Siam. Enum. 1 (1925) 133; PARKER, Ind. For. Rec. 13 (1827) 4; FOXW. Mal. For. Rec. 10 (1932) 85; BURK. Dict. (1935) 842; Sym. Mal. For. Rec. 16 (1943) 173, f. 85. — *Pterigium costatum* CORREA, Ann. Mus. Hist. Nat. Paris 8 (1806) 397, t. 65 — *Shorea costata* PRESL, Rostl. 2 (1825) 66. — *D. angustifolius* W. & A. Prod. 1 (1834) 84; DC. Prod. 16, 2 (1868) 610. — *D. lemeslei* VESQUE, C. R. As. Sc. Paris 78 (1874) 626. — *D. insularis* HANCE, J. Bot. 14 (1876) 241; PIERRE, Fl. For. Coch. 3 (1889) t. 214; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37. — *D. artocarpifolius* PIERRE [ex LANESSAN, Pl. Util. Colon. Fr. (1886) 297, *nomen*] Fl. For. Coch. 3 (1889) t. 213; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 37. — *D. parvifolius* HEIM, Bot. Tidsskr. 25 (1903) 43; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 365; CRAIB, Fl. Siam. Enum. 1 (1925) 135.

Large unbuttressed tree. Twigs, leaf buds, midrib above, petioles, inflorescences, flower calyx and petals outside densely persistently evenly pale golden-brown pubescent, leaf beneath and fruit calyx sparsely somewhat caducously so. *Twig* c. 3 mm  $\varnothing$  apically, terete, pale brown, much branched. *Buds* to 10 by 4 mm, ovoid to lanceolate, acute; *stipule* to 5 by 1 cm, lorate, tapering and subacute apically. *Leaves* 5.5–17 by 2.8–7 cm, ovate or elliptic, usually small, coriaceous; base obtuse or broadly cuneate; acumen to 6 mm long, short; nerves 11–13 (–15) pairs, ascending; tertiary nerves slender, elevated beneath; *petiole* 1.5–2.8 cm long, slender. *Inflorescence* to 7 cm long, singly branched or unbranched, bearing to 7 distichous flowers. *Flower buds* to 25 by 8 mm, fusiform. *Stamens* 18–20, shorter than style at anthesis; filaments short, lorate; anthers short, linear-lorate, tapering; appendage acicular, very slender. *c.*  $\frac{2}{3}$  length of

anther; *ovary* ovoid, tapering into the columnar style; *ovary* and basal  $\frac{1}{2}$  of style densely pubescent. *Fruit pedicel* to 3 by 2 mm; *calyx tube* to 2 cm  $\varnothing$ ,  $\pm$  subglobose, with 5 continuous, to 2 mm wide, narrow coriaceous wings; 2 longer lobes to 11.5 by 2.5 cm, lorate-oblong, narrowly obtuse, c. 8 mm wide at the subrevolute base; 3 shorter lobes to 15 by 15 mm, suborbicular, revolute, prominent.

Distr. Andamans, Chittagong, Burma, Thailand, Cambodia, Cochinchina, and in *Malesia*: Malaya (from Negri Sembilan northwards).

Ecol. Scattered in Hill and Upper Dipterocarp forests, 600–1000 m, and down to sea level in seasonal areas in N.W. Malaya. Gregarious in lowland and hill Semi-evergreen Dipterocarp forest of S.E. Asia.

Vern. *Këruing marakluang*, *k. bukit* (Malaya).

Note. Allied to *D. glandulosus* THW. of Ceylon.

**42. Dipterocarpus conformis** SLOOT. Bull. Bot. Gard. Btzig III, 17 (1941) 102, f. 13.

**a. ssp. conformis.** — *D. confertus* (non SLOOT.) SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 324 (Sumatran coll.).

Young twig, leaf bud, stipule outside, petiole, raceme and leaf beneath persistently densely pale pink-brown velutinate; leaf above caducously so except on nerves and midrib. *Twigs* verrucose. *Bud* c. 8 by 4 mm, ovoid, obtuse. *Stipules* c. 15 by 6 mm, ovoid, acute, cupped, fugaceous. *Leaves* 20–24 by 12–15 cm, obovate, chartaceous; base obtuse or subcordate, narrowly subpeltate; acumen 4–8 mm long; nerves 13–15 pairs, at c. 60°–70°; *petiole* 5–6 cm long, slender, rugose. *Raceme* to 6 cm long, short, terminal or axillary, slender, ribbed on drying, unbranched or singly branched, bearing few distichous flowers; bracts unknown. *Flower bud* to 3 by 0.8 cm. *Calyx* and *corolla* typical, calyx shortly tomentose. *Stamens* c. 30, shorter than style; filaments almost as long as anther, slender; anther linear, short, tapering at apex; appendage to connective slender, tapering, almost equal in length to anther. *Ovary* ovoid to conical, long, glabrescent at base, long tomentose medially, shortly tomentose apically; style and stylopodium c. 4  $\times$  length of ovary, slender, filiform, sparsely pubescent at base, otherwise glabrous. *Fruit calyx*  $\pm$  uniformly pubescent; tube c. 2.5 by 2 cm, ellipsoid, neck narrowed to 1–1.2 cm  $\varnothing$ ; with 5, to 10 cm wide, incrassate wings continuing from pedicel to neck, sometimes bent to one side but not undulate; 2 longer calyx lobes to 10 by 2 cm, oblong, obtuse, constricted abruptly to 7 mm broad at the base; 3 shorter lobes to 8 mm long and broad, ovate, not constricted at the base, revolute.

Distr. *Malesia*: northern half of Sumatra (Langsa, Atjeh, Ophir and Ayerbangis, W. Coast).

Ecol. Rare, lowland forests on hills.

Vern. *Këruing buah*, *lagan sanduk* (Sum.).

**b. ssp. borneensis** ASHTON, Gard. Bull. Sing. 20 (1963) 28; Man. Dipt. Brun. Suppl. (1968) 12. — *D. con-*

*formis*: ASHTON, Man. Dipt. Brun. (1964) 28, f. 6; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 244.

Differs from *ssp. conformis* as follows: *Leaves* 9–12 by 5–7 cm, nerves 15–18 pairs, *petiole* 17–25 mm long; *wings of calyx tube* to 3 mm wide.

Distr. *Malesia*: Borneo (N.E. Sarawak, Brunei, S.W. Sabah).

Ecol. Rare, Hill Dipterocarp forests, clay rich soils, below 800 m.

Vern. *Këruing beludu kuning*.

**43. *Dipterocarpus acutangulus*** VESQUE, C. R. Ac. Sc. Paris 78 (1874) 626; J. Bot. 12 (1874) 150; DYER, J. Bot. 12 (1874) 152; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 321; Reinwardtia 5 (1961) 457; SYM. Mal. For. Rec. 16 (1943) 166, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 107; ASHTON, Gard. Bull. Sing. 20 (1963) 240; Man. Dipt. Brun. (1964) 22, f. 6, 7; *ibid.* Suppl. (1968) 11; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 235, pl. 27 (habit). — *D. appendiculatus* (non SCHEFF.) DYER, J. Bot. 12 (1874) 152; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 200, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 34, *p.p.*; MERR. En. Born. (1921) 397, *p.p.* — *D. tawaensis* SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 313, f. 6. — *D. helicopteryx* SLOOT, Bull. Jard. Bot. Btzig III, 16 (1940) 441, f. 4; BROWNE, For. Trees Sarawak & Brunei (1955) 109. — **Fig. 17C.**

Twig, bud, stipule (outside only), petiole and leaf beneath at first densely buff pubescent; persistent on leaf bud and stipule,  $\pm$  caducous elsewhere. *Twig* c. 3 mm  $\varnothing$  apically, becoming glabrous, terete, with swollen amplexicaul stipule scars. *Bud* 3–12 by 2.5–5 mm, ovoid, broad and short, subacute; occasionally glabrous. *Stipule* c. 5 by 0.8 cm, linear, obtuse. *Leaves* 7–10 by 3–6 cm, elliptic to ovate; base obtuse or cuneate, apex with narrow c. 1 cm long acumen, margin sinuate; nerves 7–12 pairs, at c. 30°–45°; tertiary nerves dense, scalariform; *petiole* 1.5–2.5 cm long, to 1 mm  $\varnothing$ . *Flowers* unknown. *Raceme* to 4 cm long, axillary, slender, glabrous. *Fruit calyx* glabrous; tube to 2.5 cm broad and long, globose or ellipsoid, becoming slightly impressed at the pedicel, constricted to c. 1 cm  $\varnothing$  neck; with 5 rounded or angular woody ribs, 3–4 mm thick and c. 3 mm wide (often less pronounced), initiating from the impressed base and terminating abruptly at the insertion of the calyx lobes; surface warty, glabrous, pruinose; 2 longer lobes c. 10 by 2.5 cm, oblong-spatulate, slightly twisted, to 5 mm broad at base, 3-nerved, the 2 laterals of variable length; 3 shorter wings c. 5 mm long and broad, deltoid, subacute, with revolute margins.

Distr. *Malesia*: Malaya (rare: Negri Sembilan), Borneo (Ulu Kapuas, W. Kalimantan; Sarawak, Brunei, S.W. and E. Sabah).

Ecol. Mixed Dipterocarp forest, sandy soils on coastal hills and inland ridges to 1000 m.

Vern. *Këruing merah, k. beludu*.

Note. A polymorphic species (in this resembling *D. eurycnchus* q.v.); collections from N.W. Borneo and Malaya bear distinctly larger more thickly coriaceous

leaves and are in this respect intermediate between this species and *D. globosus* VESQUE.

**44. *Dipterocarpus sublamellatus*** Foxw. Mal. For. Rec. 10 (1932) 92, pl. 8; SLOOT, Bull. Bot. Gard. Btzig III, 17 (1941) 108, f. 15; SYM. Mal. For. Rec. 16 (1943) 92, f. 85; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 269; ASHTON, Man. Dipt. Brun. Suppl. (1968) 17, f. 3.

Leaf bud and stipule outside (glabrous within) densely long pale fulvous hirsute, rarely glabrous, leaf nervation beneath sparsely caducously so, otherwise glabrous. *Twig* to 3 mm  $\varnothing$  towards the apex, much branched, slender, dark, lustrous, smooth; stipule scars pale, prominent. *Bud* to 12 by 8 mm, ellipsoid-ovoid, subacute. *Stipule* to 40 by 8 mm, lorate, acute. *Leaves* 5–15 by 3.5–8 cm, ovate to elliptic (immature), coriaceous persistently prominently plicate; base broadly cuneate; acumen short, slender, to 1 cm long in young trees; nerves 8–12 pairs, prominent beneath, ascending at 35°–55°; tertiary nerves very slender, densely scalariform; *petiole* c. 1.5–(3) cm long, slender, geniculate, drying black or pruinose. *Inflorescence* unknown. *Flower bud* to 3.5 by 1 cm. *Calyx* and *corolla* typical; calyx glabrous. *Stamens* c. 24, as long as style at anthesis; filaments lorate, slender, compressed, somewhat longer than anther; anther linear, tapering into the acicular appendage; appendage c.  $\frac{1}{2}$  length of anther. *Ovary* ovoid, pubescent; style columnar, pubescent except in the apical  $\frac{1}{3}$ . *Fruit calyx tube* to 3 by 3 cm, globose, bearing 5, to 1.5 cm wide, incrassate undulate wings; wings tapering distally, auriculate at base; 2 longer calyx lobes to 12 by 3 cm, lorate, obtuse, c. 6 mm wide at the somewhat revolute base; 3 shorter calyx lobes to 5 by 7 mm, suborbicular, revolute.

Distr. *Malesia*: Malaya, Sumatra (Sibolga, Tapanuli, Indragiri), Borneo (Sarawak, west of the R. Suai in W.; Sebatik island and Nunukan in N.E.).

Ecol. Undulating land and low hills to 500 m, locally common, especially in moist places.

Vern. *Këruing kërut, k. padi, k. sugi* (Malaya), *lagan batu, l. boeih, masibuk* (Sumatra).

Note. Collections from N.E. Borneo, and one from Central Sarawak (S 18428) have somewhat larger parts, especially fruit, and less undulate calyx tube wings.

Closely related to *D. insignis* THW. of Ceylon.

**45. *Dipterocarpus concavus*** Foxw. Mal. For. Rec. 10 (1932) 90, pl. 7; SLOOT, Bull. Bot. Gard. Btzig III, 17 (1941) 101, f. 12; SYM. Mal. For. Rec. 16 (1943) 171, f. 85. — *D. confertus* (non SLOOT.) SLOOT, Bull. Jard. Bot. Btzig III, 7 (1927) 324, *quoad spec.* Lingga.

Large buttressed tree. *Twig*, leaf bud, stipule outside, petiole, midrib above and inflorescence densely shortly yellow-brown tufted tomentose, leaf under-surface and nervation above more sparsely so, flower calyx and ovary densely yellow-brown puberulent, fruit calyx glabrescent. *Twig* c. 3 mm  $\varnothing$  apically, terete. *Buds* to 11 by 6 mm, narrowly ovoid, acute; expanded stipule unknown. *Leaves* 10–23 by 6–17 cm,



broadly elliptic,  $\pm$  chartaceous,  $\pm$  prominently concave beneath; base obtuse, apex  $\pm$  shortly prominently cuspidate, obtuse; nerves *c.* 12 pairs, prominently raised beneath as also the midrib; tertiary nerves remotely scalariform; *petiole* 3.5–6 cm long, *c.* 3 mm  $\varnothing$ , long. *Inflorescence* to 6 cm long, axillary, unbranched, bearing to 3 flowers. *Flower buds* to 3.5 by 1 cm, lanceolate. *Stamens* 25; mature flowers unknown. *Fruit* subsessile; *calyx tube* to 4.5 by 3.5 cm including the 5, to 1.5 cm wide, prominent continuous coriaceous wings, the tube itself *c.* 1.5 cm  $\varnothing$ , subglobose, the wings decurrent basally with the pedicel axis and apically with the base of the lobes; 2 longer lobes to 16 by 4 cm, broadly lorate, obtuse, hardly tapering but undulate at base; 3 shorter lobes to 1.5 by 1.2 cm, suborbicular, with narrowly revolute margin.

Distr. *Malesia*: Malaya (Pahang and Perak northwards), Sumatra (P. Singkep).

Ecol. Local, on well-drained flat land.

Vern. *Kěruing sendok*, *k. dadah*, *damar liat* (Malaya), *k. lakis*, *k. jantong* (Singkep).

Note. The Singkep specimens are sterile and might be *D. confertus*.

**46. *Dipterocarpus stellatus*** VESQUE, C. R. Ac. Sc. Paris 78 (March 1874) 626; J. Bot. 12 (1874) 150; DYER, J. Bot. 12 (1874) 153; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 202; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 38; BOERL. Cat. Hort. Bog. 2 (1901) 99; MERR. En. Born. (1921) 400; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 335; Reinwardtia 5 (1961) 465, f. 3; BROWNE, For. Trees Sarawak & Brunei (1955) 111; ASHTON, Gard. Bull. Sing. 20 (1963) 239; Man. Dipt. Brun. Suppl. (1968) 17. — *D. nobilis* DYER, J. Bot. 12 (Apr. 1874) 106; *ibid.* (May 1874) 153.

**a. *ssp. stellatus*.**

Young twig, raceme, leaf bud, stipule outside, midrib on both surfaces and petiole  $\pm$  densely persistently long rust-brown tomentose, sparsely so on leaf nervation beneath. *Twig* to 7 mm  $\varnothing$ ,  $\pm$  angular, with an uneven cracked surface and large round petiole scars. *Leaf bud* 5–8 by 3–5 mm, spherical, obtuse. *Stipule* *c.* 2 by 0.8 cm, deltoid, acute. *Leaves* 20–25 by 12–16 cm, ovate, thinly coriaceous; base cordate; acumen to 14 mm long, nerves 12–16 pairs, well spaced, at *c.* 55°–60°; *petiole* 4–5 cm long. *Raceme* to 20 cm long, axillary, angular on drying, unbranched or singly branched. *Flower bud* to 6 by 2 cm, large. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* *c.* 30, subequal; filaments slender, compressed at base, tapering; anthers linear,  $\pm$  twice as long as filaments, expanded into small lateral knobs at base, tapering; appendage to connective filiform, as long as anther, reaching almost to style apex. *Ovary* small, ovoid; style *c.* 5  $\times$  length of ovary, stoutly filiform, densely pubescent at base, sparsely so distally, glabrous in the apical  $\frac{1}{2}$ . *Fruit* sessile or on to 2 mm long stout pedicel. *Fruit calyx tube* to 5 by 2 cm, obconical, the nut enclosed in the distal half, the basal *c.* 1.4 cm a narrow central axis on which the wings are

fused; glabrous, smooth, *c.* 2.5 cm  $\varnothing$  at neck (including wings); wings *c.* 1.2 cm wide, thin, undulate,  $\pm$  bent over on one side at maturity, continuous from the base to the calyx lobes; concurrent with the margins of the lobes; 2 longer lobes *c.* 12 by 3 cm, oblong, obtuse, with undulate margin at the *c.* 1.7 cm wide base; with 3 parallel nerves, close to the centre, continuing to the apex; 3 shorter lobes *c.* 1 cm long and broad, deltoid, obtuse, with an undulate revolute margin.

Distr. *Malesia*: Borneo (Sarawak west of the Lupar).

Ecol. Hill forests, 500–800 m, local.

Note. Immature plants of the two subspecies can be indistinguishable.

**b. *ssp. parvus*** ASHTON, Gard. Bull. Sing. 20 (1963) 239; Man. Dipt. Brun. Suppl. (1968) 170. — *D. conformis sensu* ASHTON, Man. Dipt. Brun. (1964) 45; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 268.

Differs from *ssp. stellatus* as follows: *Twig* *c.* 2 mm  $\varnothing$ ; *leaves* 10–15 by 5–7 cm, base obtuse, acumen to 8 mm long, *petiole* *c.* 2 cm long; *racemes* to 10 cm long.

Distr. *Malesia*: Borneo (Rejang eastwards to E. Sabah, Tidung, and Belajan R.).

Ecol. Undulating land and hills to 700 m on leached clay rich soil, including acid volcanics.

Vern. *Kěruing bulu*, *k. daun nipis*.

Note. Closely allied to *D. concavus* of E. Malaya, which differs principally in the concave leaf.

**47. *Dipterocarpus sarawakensis*** [BROWNE, For. Trees Sarawak & Brunei (1955) 111, *nomen*] SLOOT. Reinwardtia 5 (1961) 465, f. 2; KOCHUMMEN, Mal. For. 25 (1962) 163; ASHTON, Man. Dipt. Brun. (1964) 43, f. 6; *ibid.* Suppl. (1968) 17, pl. 3 (bark).

Twig, leaf bud, raceme, stipule outside, midrib on both surfaces, and nerves below densely persistently tawny tomentose; nerves above and tertiary nerves beneath sparsely tomentose; leaf margin setose. *Twig* 3–4 mm  $\varnothing$ , terete. *Bud* 6–10 by 3 mm, ovoid, acute. *Stipule* *c.* 1.5 cm long, small, narrowly ovate, obtuse. *Leaves* 5.5–8 by 3.5–5 cm, broadly obovate, applanate, margin straight and revolute towards the cuneate apex, becoming sinuate towards the obtuse or retuse apex; nerves 7–8 pairs, distant, ascending (30°–35°); *petiole* 0.7–1.0 cm long, stout. *Raceme* to 7 cm long, unbranched or singly branched, terete. *Flower bud* to 2.5 by 1 cm. *Calyx* and *corolla* typical, calyx glabrous. *Stamens* 15, shorter than the style; filaments short; anthers narrowly oblong, relatively short, stout; appendage to connective stout at base, tapering gradually, short,  $\frac{2}{3}$  length of anther. *Ovary* globose, tomentose as also the narrowly cylindrical style and stylopodium. *Fruit* subsessile, glabrescent; *calyx tube* to 2.5 by 1.3 cm, fusiform, broadest towards the base, tapering to the pedicel and more gradually to the 6 mm  $\varnothing$  neck; 5-winged, wings thin and papery, striated, strongly undulate, to 8 mm broad towards the apex, tapering to the pedicel or terminating somewhat above it, tapering more rapidly apically and joining with the base of the lobes; 2 longer

calyx lobes to 9 by 2 cm, oblong, obtuse; bases constricted to c. 6 mm broad, with slightly revolute margins, with 2 lateral nerves running up half the length of the lobe and one median nerve dividing into three after the termination of the laterals; 3 short lobes 0.8–1.5 by 0.5 cm, ovate, completely revolute, narrowly acute.

Distr. *Malesia*: Malaya (river Kemaman, Trengganu, one record), S. Borneo (Barito), Sarawak and Brunei.

Ecol. Locally frequent on leached sandy soils on low coastal hills to 400 m.

Vern. *Kěruing layang*.

**48. *Dipterocarpus coriaceus*** SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 331, f. 11; SYM. Mal. For. Rec. 16 (1943) 171, f. 85; BROWNE, For. Trees Sarawak & Brunei (1955) 108; ANDERSON, Gard. Bull. Sing. 20 (1963) 157; ASHTON, Man. Dipt. Brun. Suppl. (1968) 12, f. 2. — *D. dyeri* (non PIERRE) FOXW. Mal. For. Rec. 10 (1932) 80, p.p.

Leaf beneath, petiole and twig shortly densely evenly pale pink-brown pubescent; leaf bud, stipule outside and midrib beneath, twig and petiole of young tree with to 2 mm long dense hairs; stipule glabrous within. *Twig* 8–13 mm  $\varnothing$ , stout, terete, with subhorizontal stipule scars; internodes 3–10 mm long, short. *Bud* 2.5–3 by 1.0–1.7 cm, ovoid-deltoid; *stipule* to 4 by 2 cm, narrowly ovate, subacute. *Leaves* 16–21 by 10–15 cm, broadly elliptic-ovate, thickly coriaceous, with obtuse or broadly cuneate base and obtuse to subacute apex; nerves 14–16 pairs, at 20°–60°, prominent beneath, depressed above, the midrib likewise; tertiary nerves obscure, scalariform; *petiole* 4.5–6 cm long, prominently geniculate. *Flower* and *inflorescence* unknown. *Fruit pedicel* to 7 mm long, prominent. *Fruit calyx* glabrous; tube to 3 by 2.2 cm,  $\pm$  broadly ovoid, with 5, to 5 mm wide, stout wings or ribs, tapering abruptly at the apex and gradually towards the base, absent in the basal  $\frac{1}{4}$  of the tube; 2 longer lobes to 14 by 2.5 cm, spatulate, narrowly obtuse, to 5 mm broad above the tube; 3 shorter lobes to 14 by 2.5 cm, spatulate, narrowly obtuse, to 5 mm broad above the tube; 3 shorter calyx lobes to 12 by 6 mm, elliptic, obtuse, applanate to slightly revolute.

Distr. *Malesia*: Malaya (Lower Perak, Pahang), Sumatra (Indragiri), Borneo (Lower Kapuas, Sukadana, Lower Dayak, and Lundu to K. Balingian in Sarawak).

Ecol. Local, in Mixed Peat swamp forest.

Vern. *Kěruing paya* (Sar.), *kědau*, *tampurau* (S.E. Borneo).

Note. Malayan collections have smaller fruit with narrower wings on the tube, and glabrescent leaf beneath in mature trees.

**49. *Dipterocarpus cuspidatus*** ASHTON, Gard. Bull. Sing. 23 (1967) 261, pl. 2; Man. Dipt. Brun. Suppl. (1968) 13, f. 2.

Leaf bud densely persistently long buff tomentose;

twig, petiole, midrib above and leaf nervation beneath sparsely long pale grey-brown subsistent tomentose. *Twig* c. 1 mm  $\varnothing$  apically, slender, terete, much branched; stipule scars slender, obscure. *Bud* to 7 by 3 mm, oblong; *stipule* unknown, caducous. *Leaves* 6–11 by 2–4 cm, narrowly elliptic-ovate, applanate with plicate folding almost disappearing when fully expanded; base obtuse to rarely cuneate; acumen to 2 cm long, prominent, slender, cuspidate; nerves 8–9 pairs, slender but prominent beneath, at 40°–50°; tertiary nerves densely scalariform; midrib slender, prominent beneath; *petiole* 12–18 mm long, slender, geniculate. *Flower* unknown. *Raceme* to 5 cm long, terminal or axillary, terete, slender, sparsely persistently long grey-brown tomentose, singly branched. *Fruit pedicel* to 5 mm long, prominent. *Calyx* glabrous; 2 longer lobes to 8 by 1.8 cm, spatulate, obtuse to subacute, c. 6 mm broad at the tube; 3 shorter lobes to 9 by 4 mm, oblong, obtuse, somewhat revolute; tube to 2 cm long, to 1.8 cm  $\varnothing$ , with 5 prominent wings; wings thin, somewhat undulate, tapering into the base but to 9 mm broad and subauriculate apically. *Nut* to 3 by 1.6 cm, ovoid, greatly exceeding the length of the calyx tube.

Distr. *Malesia*: Borneo (N.E. Sarawak).

Ecol. Rare: Mixed Dipterocarp forest on undulating land and low hills.

Vern. *Kěruing runching*.

**50. *Dipterocarpus eurynchus*** MIQ. Sum. (1862) 485; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 613; WALP. Ann. 7 (1869) 377; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 203; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 273, 302; ASHTON, Gard. Bull. Sing. 20 (1963) 238; Man. Dipt. Brun. (1964) 30, f. 6; *ibid.* Suppl. (1968) 14; Gard. Bull. Sing. 31 (1978) 12. — *D. eurynchoides* SCHEFF. Nat. Tijds. N.I. 31 (1870) 346; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 203; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 273, 302. — *D. appendiculatus* SCHEFF. Nat. Tijds. N.I. 31 (1870) 347; *ibid.* 32 (1873) 407; DYER, J. Bot. 12 (1874) 104, p.p.; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 200, p.p.; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 34, p.p.; MERR. En. Borneo. (1921) 397, p.p.; HEYNE, Nutt. Pl. ed. 2 (1927) 1094; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 326; Reinwardtia 5 (1961) 458; FOXW. Mal. For. Rec. 10 (1932) 83, *in obs.*; SYM. Mal. For. Rec. 16 (1943) 167, f. 85. — *D. basilanicus* FOXW. Philip. J. Sc. 13 (1918) Bot. 179; *ibid.* 67 (1938) 259; MERR. En. Philip. 3 (1923) 88.

Leaf bud densely persistently long buff tomentose; twig, petiole and leaf nervation beneath sparsely long pale grey-brown subsistent pubescent; stipule persistently so. *Twigs* to 2 mm  $\varnothing$  apically, terete, smooth or verrucose; stipule scars slender. *Bud* to 10 by 3 mm, conical, obtuse or subacute. *Stipule* to 3 by 0.8 cm, narrowly oblong, subacute. *Leaf* 4–6(–10) by 2–3.5(–4.5) cm, elliptic to obovate; base cuneate; apex subacute to shortly acuminate (caudate in young trees); nerves 8–9 pairs, at c. 40°; tertiary nerves



slender, dense; *petiole* 6–9 mm long, slender. *Flower* unknown. *Raceme* to 6 cm long, axillary, terete or ± compressed, glabrous, simple or singly branched. *Fruit calyx* glabrous; tube to 1.7 by 2 cm, 5 winged; wings c. 2.5 mm wide, thin, continuous from base to apex, straight, rigid, frequently becoming bent over to one side; 2 longer lobes to 8 by 2 cm, oblong, obtuse, tapering and revolute at base; 3 shorter lobes to 7 by 5 mm, ovate, obtuse, becoming revolute.

*Distr. Malesia:* Malaya (E. coast, Trengganu to N.E. Johore), Sumatra (E. Atjeh, Langsa, P. Singkep, Banka), Borneo (W. Borneo, Sarawak, Brunei), S. Philippines (rare).

*Ecol.* Local, on undulating land in Mixed Dipterocarp forest on leached clay soils, and on ridge tops to 700 m.

*Vern. Kěruing baran, k. padi* (Mal.), *sēmanto minjak, kěrukēh, ansang ansang, kěruing, kěruing senium* (Sum.).

*Note.* A polymorphic species. One distinctive and well collected segregate is recognised here as a separate species, *D. ochraceus*; others, presently ill understood, may eventually deserve taxonomic definition: The few Malayan and Sumatran collections have markedly larger leaves with longer petioles, and collections from Gunong Angsi, Negri Sembilan (including KEP 23788, quoted by SYMINGTON (1943) as a possible hybrid between *D. gracilis* and *D. costatus*) come close to *D. ochraceus*. This species is apparently derived from the widespread *D. costatus* of the seasonal zone, as may be the closely similar *D. glandulosus* THW. of Ceylon.

**51. *Dipterocarpus ochraceus* MEIJER**, Acta Bot. Neerl. 12 (1963) 351, pl. 14; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 26.

Large tree. Young parts densely ocherous velutinate, persistent on leaf buds, stipules outside, and twigs, becoming sparse yet partially persisting on petiole and nervation beneath, caducous on other known parts. *Twigs* c. 4 mm Ø apically, rather stout, terete, ± minutely fissured. *Buds* to 20 by 8 mm, large, ovoid-lanceolate, acute; mature *stipules* unknown. *Leaves* 10–19 by 4.5–9.5 cm, broadly elliptic-ovate, coriaceous, ± persistently plicate; base cuneate or rarely obtuse; acumen to 15 mm long, broad; nerves 11–15 pairs, slender but prominent beneath, ascending at 30°–60°; tertiary nerves densely subscalariform, slender but distinctly elevated beneath; midrib prominent beneath, ± applanate above; *petiole* 1.5–2.5 cm long, stout. *Inflorescences* and *flowers* unknown. *Fruit pedicel* to 3 by 2 mm, prominent. *Calyx tube* to 18 by 15 mm, broadly ellipsoid, with 5, to 2 mm broad, continuous straight coriaceous wings; 2 longer lobes to 8 by 1.8 cm, lorate-spatulate, narrowly obtuse, c. 6 mm broad at base; 3 shorter lobes to 6 by 6 mm, ovate, subacute, subrevolute.

*Distr. Malesia:* N.E. Borneo (Kinabalu area).

*Ecol.* Ultrabasic and basaltic mountains, 600–700 m.

*Vern. Kěruing ranau.*

*Note.* A species which has presumably segregated from the widespread *D. eurynchus*; see there.

**52. *Dipterocarpus perakensis* ASHTON**, Gard. Bull. Sing. 31 (1978) 13. — *D. alatus* (non ROXB.) FOXW. Mal. For. Rec. 10 (1932) 89, p.p.; SYM. Mal. For. Rec. 16 (1943) 166, f. 85.

Large tree. Parts glabrous but for the cream puberulent ovary apex. *Twigs* c. 2 mm Ø apically, much branched, blackish. *Buds* to 9 by 2 mm, lanceolate, drying blackish; *stipules* unknown. *Leaves* 4–7 by 8–13 cm, elliptic, coriaceous; base broadly cuneate to obtuse; apex shortly acuminate; nerves 9–12 pairs, ascending, prominent beneath; tertiary nerves densely scalariform, slightly elevated beneath; *petioles* 1.5–3.2 cm long, slender. *Flowers* and *inflorescences* unknown. *Fruit pedicel* to 2 by 2 mm; *calyx tube* to 2.2 cm Ø, subglobose, with 5 prominent continuous to 8 mm wide coriaceous wings; 2 longer lobes to 12 by 3 cm, oblong-lorate, obtuse, tapering abruptly to c. 8 mm wide at the revolute base; 3 shorter lobes to 5 by 5 mm, suborbicular, subrevolute, small.

*Distr. Malesia:* Malaya (Penang hill, Dindings, Pangkor I.).

*Ecol.* Very local, in Lowland Dipterocarp forest on coastal hills.

*Note.* This species is a segregate from *D. eurynchus* MIQ. and *D. costatus* GAERTN. f., clearly distinguished by the relatively broad wings on the fruit calyx tube and conspicuous lack of tomentum.

**53. *Dipterocarpus philippinensis* FOXW.** Philip. J. Sc. 6 (1911) Bot. 253; *ibid.* 13 (1918) Bot. 179; *ibid.* 67 (1938) 263; MERR. En. Philip. 3 (1923) 90.

Tall tree. Leaf buds, twigs, stipules, leaf nervation beneath, midrib above, petiole, inflorescence and ovary densely evenly shortly persistently pale ocherous pubescent, leaf surface sparsely so; fruit calyx glabrous. *Twigs* 3–4 mm Ø apically, ± terete, pale brown. *Leaf buds* to 15 by 6 mm, lanceolate; expanded *stipules* not seen. *Leaves* 9–17 by 3.5–8 cm, narrowly ovate, thinly coriaceous; base cuneate; apex acute or shortly indistinctly acuminate; nerves 11–18 pairs, slender but prominent beneath, ascending at 45°; tertiary nerves densely scalariform, sinuate, very slender but somewhat elevated beneath; *petioles* 2.5–4.5 cm long, slender. *Inflorescence* to 8 cm long, unbranched, bearing to 4 flowers. *Flowers* unknown. *Fruit pedicel* c. 1 mm long, short; *calyx tube* to 2.3 cm Ø, subglobose, with 5, to 8 mm broad, prominent continuous coriaceous wings; 2 longer lobes to 14 by 2.8 cm, lorate, obtuse, c. 1 cm broad at the subrevolute base; 3 shorter lobes to 12 by 14 mm, ovate, suborbicular, revolute.

*Distr. Malesia:* Philippines (Luzon; Bataan and Abra Prov.).

*Ecol.* Rare, in Mixed Dipterocarp forest in seasonal areas.

*Vern. Ayamban* (Ilk.).

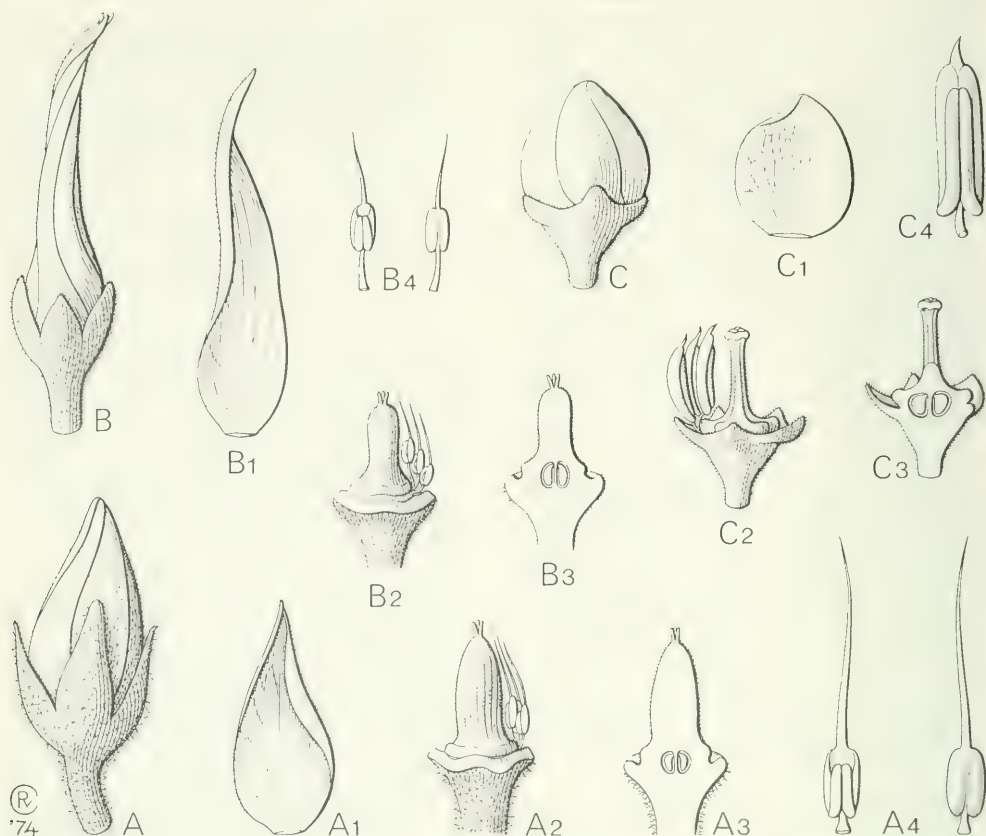


Fig. 27. *Anisoptera costata* KORTH. A. Bud, A1. petal, A2. stamens and pistil, A3. pistil in section, all  $\times 5$ , A4. stamens from inside (left) and outside,  $\times 10$ . — *A. thurifera* (BLCO) BL. B. bud, B1. petal, B2. stamens and pistil, B3. pistil in section, all  $\times 5$ , B4. stamens from inside (left) and outside,  $\times 10$ . — *A. laevis* RIDL. C. bud, C1. petal, C2. stamens and pistil, C3. pistil in section, all  $\times 5$ , C4. stamen from inside,  $\times 10$  (A POILANE 830, B KOSTERMANS & SOEGENG 286, C S 24810).

#### Dubious

54. *Dipterocarpus orbicularis* FOXW. Philip. J. Sc. 13 (1918) Bot. 180; *ibid.* 67 (1938) 262; MERR. En. Philip. 3 (1923) 907.

Leaf buds, twigs, leaf nervation beneath and peduncle  $\pm$  sparsely fulvous hirsute, lamina beneath, midrib above and ovary sparsely puberulent; fruit calyx glabrous. Twigs c. 5 mm  $\varnothing$  apically, terete, pink-brown. Leaf buds to 12 by 6 mm, ovoid-lanceolate; stipules not seen. Leaves 9–13 by 6.5–10 cm, broadly elliptic, thinly coriaceous; base cuneate; apex mucronate; nerves 10–12 pairs, slender but prominent beneath, shallowly depressed above, ascending at  $45^\circ$ ; tertiary nerves laxly subscleriform, elevated beneath; petioles 2.5–4.5 cm long, slender. Inflorescences to 12 cm long, unbranched, bearing to three flowers. Flowers and mature fruit unknown. Young fruit pedicel to 2 mm long; calyx tube with 5 prominent

chartaceous broad wings from base to apex; calyx lobes unequal, 2 aliform.

Distr. *Malesia*: Philippines (Camarines Prov., Luzon).

Ecol. Mixed Dipterocarp forest at low elevations.

Notes. The type (FB 21719 from Camarines, Luzon) consists of a leafy twig and an immature fruit. This little known species, which in the absence of ripe fruit cannot be placed in the key, resembles *D. grandiflorus* BLCO in its fruit and *D. gracilis* BL. in its indumentum. The leaf, almost orbicular and with few nerves, is distinctive. Sterile specimens from Sabah compared by FOXWORTHY with this species belong to the subsequently described *D. confertus* SLOOT., in which the leaves are much larger, the fruit calyx densely pubescent and with narrower wings. *D. orbicularis* would appear to be vicarious with *D. stellatus* VESQUE of Borneo and *D. concavus* FOXW. of the Malay Peninsula.



## 2. ANISOPTERA

KORTH. Kruidk. (1841) 65; WALP. Rep. 5 (1845) 125; Ann. 4 (1857) 335; BL. Ann. Mus. Lugd.-Bat. 2 (1852) 6; MIQ. Fl. Ind. Bat. 1, 2 (1859) 500; B. & H. Gen. Pl. 1 (1862) 500; DC. Prod. 16, 2 (1868) 615; DYER, Fl. Br. Ind. 1 (1874) 300; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220; HEIM, Rech. Dipt. (1892) 30; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 258; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 359; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1926) 3; HEYNE, Nutt. Pl. ed. 2 (1927) 1098; FOXW. Philip. J. Sc. 67 (1938) 263; SYM. Gard. Bull. S. S. 8 (1934) 1; Mal. For. Rec. 16 (1943) 199, f. 99 (map); WYATT-SMITH, Mal. For. 18 (1955) 70; ASHTON, Gard. Bull. Sing. 20 (1963) 230; Man. Dipt. Brun. (1964) 9; MEIJER & WOOD, Sabah For. Rec. 5 (1965) 292; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 18. — *Hopea* ROXB. Fl. Ind. ed. Carey 2 (1832) 611, *p.p.*, quoad *H. scaphula* ROXB. — *Mocanera* BLCO, Fl. Filip. ed. 1 (1837) 446, *p.p.*, quoad *M. thurifera* BLCO. — *Vatica* (*non* L.) DYER, Fl. Br. Ind. 1 (1874) 301, *p.p.*, quoad *V. scaphula*. — *Antherotriche* TURCZ. Bull. Soc. Nat. Mosc. 2 (1846) 505. — *Scaphula* PARKER in Fedde, Rep. 30 (1932) 326. — *Hopeoides* CRETZOIU, J. Jap. Bot. 17 (1941) 408. — **Fig. 27–31.**

Medium-sized to very large trees, often with prominent, thick, rounded, tall straight buttresses. *Crown* comparatively small, appearing irregularly hemispherical and oblong, rather diffuse, with a few large twisted branches ascending from the bole apex; branchlets not crowded towards the apices. *Bark surface* rather shallowly irregular-section fissured, the fissures separating  $\pm$  flat flaking ridges; dotted with warty lenticels. Young parts at first  $\pm$  densely lepidote with emarginate peltate hairs; lamina undersurface persistently so. *Twigs* ribbed. *Stipules* relatively large, narrow, fugaceous. *Leaves* oblong to obovate, base usually obtuse, apex shortly acuminate; nerves curving round and anastomosing at the apices, thus forming a looped intramarginal nerve (*cf.* *Cotylelobium*); tertiary nerves densely or remotely scalariform; *petiole* distinctly geniculate. *Inflorescence* long, lax, pendent, densely tomentose; bracteoles small, linear, caducous. *Flower bud* distinctly pedicellate, distichous. *Calyx*  $\pm$  imbricate, rarely valvate (*A. laevis*); with 2 obtuse outer lobes slightly more thickened than 3 inner acute lobes, united at base in an indistinct (in flower) tube round the partially inferior ovary. *Petals* oblong-linear, falling separately. *Stamens* 15–65 in 3 verticils or irregular, the outer somewhat shorter than the inner, glabrous; filaments rather short, slender, filiform, tapering, connate at base; anthers with 4 pollen sacs, the inner 2 shorter than the outer 2, latrorse; appendage to connective short or long. *Ovary* semi-inferior, with a distinct stylopodium; style long or short, obscurely trifid; stigma indistinct. *Fruit calyx* valvate with an ellipsoid basal tube almost entirely enclosing and adnate to the nut, with 2 long narrowly spatulate obtuse untwisted 3-nerved lobes, and 3 acuminate short lobes. *Nut*  $\pm$  globose, enclosed but for the apex in the valvate tube, with distinct stylopodium. Germination epigeal, pericarp splitting open irregularly apically; cotyledons unequal; first leaves paired, with interpetiolar stipules, or in a whorl of 4, without stipules; followed by spiral leaves as other genera.

Distr. 11 *spp.* from Chittagong and Indochina to New Guinea, in *Malesia*: 10 *spp.* Holocene fossils have been found in the Siwalik beds of N.W. India. Fig. 28.

Ecol. Lowland forests, rarely above 1000 m. Scattered in Mixed Dipterocarp, Mixed Swamp and Heath forests of the humid zone but becoming gregarious in N. Malaya, Indochina and parts of New Guinea.

Uses. The pale siliceous wood is not durable without preservatives and blunts saws but is an important source for veneers.

## KEY TO THE SPECIES

1. Flower buds lanceolate. Stamens 25–60. Stylopodium in flower as broad as ovary, ovoid to oblong, tomentose. Style short, 3- or 6-furcate, stigma minute. *Spp. 1–8* 1. *Sect. Anisoptera*
2. Stamens c. 25.
3. Nerves at most 14 pairs; leaves fugaceous pubescent or epilose . . . . . 1. *A. marginata*
3. Nerves at least 15 pairs, petiole and nervation beneath  $\pm$  persistently pubescent.
4. Leaf undersurface brilliant gold lepidote, nerves depressed above . . . . . 2. *A. curtisii*
4. Leaf undersurface dull yellowish or greenish lepidote; nerves hardly or not depressed above . . . . . 3. *A. costata*
2. Stamens at least 30.
5. Twigs and nerves and midrib beneath dark rufous scabrid tomentose; lamina golden yellow lepidote beneath; nerves and tertiary nerves  $\pm$  prominently depressed above. . . . . 4. *A. grossivenia*
6. Nerves 18–28 pairs; stamens c. 36 . . . . . 5. *A. megistocarpa*
6. Nerves 23–33 pairs; stamens c. 60 . . . . .
5. Twigs and nervation not as above.
7. Nerves 9–14 pairs; twigs and leaves glabrescent . . . . . 6. *A. reticulata*
7. Nerves (10–)14–18(–20) pairs; twigs, petioles and nervation beneath pubescent.
8. Stamens 37–57; leaves greyish to brown lepidote beneath . . . . . 7. *A. thurifera*
8. Stamens 35–38; leaves densely golden peltate beneath . . . . . 8. *A. aurea*
1. Flower buds subglobose. Stamens 15. Stylopodium broad and disc-like, glabrous. Style slender, columnar; stigma obscurely 3-lobed. *Spp. 9–10* 2. *Sect. Glabrae*
9. Leaf 8–16 by 3.5–8 cm; undersurface pale grey-green lepidote; nerves 13–18 pairs . . . . . 9. *A. scaphula*
9. Leaf 7–11 by 3–4 cm; undersurface rust to golden lepidote; nerves 10–14 pairs . . . . . 10. *A. laevis*

## 1. Section Anisoptera

ASHTON, Gard. Bull. Sing. 20 (1963) 231; Man. Dipt. Brun. (1964) 10. — *Antherotriche* TURCZ. l.c. — *Anisoptera* sect. *Pilosae* HEIM, Rech. Dipt. (1892) 33; SYM. Mal. For. Rec. 16 (1943) 199. — *Anisoptera* sect. *Antherotriche* HEIM, Rech. Dipt. (1892) 34.

Young parts and leaf below generally tomentose. Flower buds lanceolate; anther ellipsoid; appendage to connective many times longer than anthers, slender; stylopodium cylindrical to ovoid, conical, narrow; style short, stigma minute.

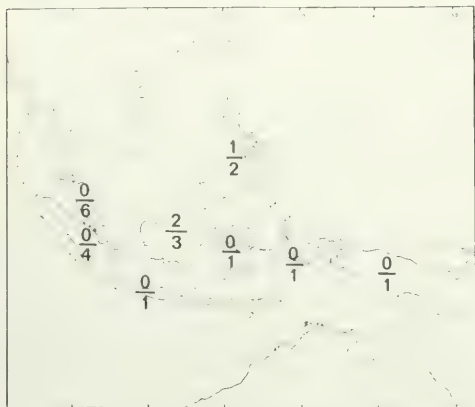


Fig. 28. Density map of *Anisoptera* KORTH. in Malasia; number of endemics above the hyphen, number of non-endemics below it.

1. *Anisoptera marginata* KORTH. Kruidk. (1841) 66, t. 6, 1a–13a; WALP. Rep. 5 (1845) 124; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 42; MIQ. Fl. Ind. Bat. 1, 2 (1859) 501; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 615; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 43; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 258; BOERL. Cat. Hort. Bog. 2 (1901) 100; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 275; ed. 2 (1927) 1099; MERR. En. Born. (1921) 401; RIDL. Fl. Mal. Pen. 1 (1922) 21; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1926) 5; FOXW. Mal. For. Rec. 10 (1932) 96; SYM. Gard. Bull. S. S. 8 (1934) 13, pl. 3C; Mal. For. Rec. 16 (1943) 206, f. 101, 103; BURK. Dict. (1935) 163; WYATT-SMITH, Mal. For. 18 (1955) 76; ANDERSON, Gard. Bull. Sing. 20 (1963) 157; ASHTON, Gard. Bull. Sing. 20 (1963) 232; Man. Dipt. Brun. (1964) 14, f. 5; *ibid.* Suppl. (1968) 5; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 298, f. 49B. — *A. grandiflora* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 43; MERR. En. Born. (1921) 401; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1926) 10. — *A. mindanensis* (non



FOXW.) WYATT-SMITH, Mal. For. 18 (1955) 77, p.p. — Fig. 29.

Young twig, leaf bud, stipule outside (glabrous within), midrib beneath and petiole shortly caducous pubescent; panicle persistently so. Twig terete, becoming angular on drying, smooth or with very fine striation. Bud 2.3–3.5 by 2 mm, ovoid, acute, compressed. *Stipule* c. 8 mm long, linear, obtuse. *Leaf* 7–10 by 3.5–4.5 mm, oblong to  $\pm$  obovate, densely golden-brown lepidote beneath, bullate in young trees, otherwise applanate, with obtuse or broadly cuneate base; acumen to 6 mm long; nerves 10–14 pairs, slender, at c. 65–70° to the midrib; *petiole* 1.5–2 cm long, slender. *Panicle* to 14 cm long, terminal or axillary, lax, pendent, terete; irregularly doubly branched. *Flower bud* to 8 by 3.5 mm, lanceolate, acute. *Calyx* cupped at base; lobes subequal, narrowly deltoid, the 3 outer slightly narrower, acute, the 2 inner obtuse. *Corolla* pale yellow; petals broadly elliptic, fimbriate. *Stamens* c. 25; filaments short, slender; anther oblong; appendage to connective c. 2 times length of anther, reaching apex of stylopodium. *Stylopodium* cylindrical, shortly densely tomentose; style short, tapering, stout at base, the basal half tomentose, otherwise glabrous, trifurcate. *Fruit calyx* shortly pubescent; tube c. 1.3 cm  $\varnothing$ , globose, to 8 mm  $\varnothing$  at the neck; 2 longer calyx lobes to 12 by 2 cm, spatulate, obtuse; 3 shorter lobes 1.5–2 cm long, c. 3 mm broad at base, linear, acute; *apex of nut* almost flat, tapering abruptly to the c. 3 mm long, c. 1.5 mm  $\varnothing$  oblong stylopodium.

Distr. *Malesia*: Malaya (E. and W. coast, Perak and Pahang southwards), Banka, E. Sumatra (Asahan southwards to Lampong), Borneo.

Ecol. Widespread but rarely common, Mixed Peat Swamp forest; local, Heath forest on podsols, to 1200 m.

Vern. *Mērsawa paya* (Mal.), *pangiran kērangas* (Sabah), *kētimpun*, *rēsak gunong* (S. Borneo), *tēnam*, *mentanam*, *sēsawah*, *rēsak pantai*, *masēgar* (Sum.).

**2. *Anisoptera curtisii* DYER** ex KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 100, incl. *var. latifolia* KING; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 263, t. 122, f. F; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 42; BURK. J. Str. Br. R. As. Soc. 81 (1920) 51, 63, fig.; MERR. En. Born. (1921) 400; RIDL. Fl. Mal. Pen. 1 (1922) 218; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 259; SLOOT. Bull. Jard. Bot. Btzg III, 8 (1926) 11, p.p.; FOXW. Mal. For. Rec. 3 (1927) 79; *ibid.* 10 (1932) 99; Philip. J. Sc. 67 (1938) 271; SYM. Gard. Bull. S.S. 8 (1934) 15, pl. 4B; Mal. For. Rec. 16 (1943) 204, f. 100B, 101.

Large buttressed tree. Twig apices, stipules, leaf buds, nervation beneath, petiole, panicles and calyx  $\pm$  densely gold-brown pubescent, caducous on twigs and calyx; leaf beneath brilliant gold lepidote. *Twig* c. 2 mm  $\varnothing$  apically, slender, becoming pale brown; stipule scars obscure. *Bud* to 6 by 4 mm, ovoid, acute; *stipules* to 7 by 2 mm, linear-lanceolate, acute, fugaceous. *Leaves* (4–)7–14 by (1.5–)2.5–6 cm, nar-



Fig. 29. Habit of *Anisoptera marginata* KORTH. Note the colossal size by the person standing in front of the flying buttresses. Palembang (Photogr. THORENAAR, 1925).

rowly elliptic to oblanceolate, coriaceous; base obtuse; acumen to 1 cm long, broad; nerves 15–25 pairs, spreading, with short secondary nerves, slender but prominent beneath, narrowly depressed above as also the midrib; tertiary nerves laxly subreticulate,  $\pm$  elevated beneath; *petiole* 13–23 mm long, slender. *Panicle* to 18 cm long, terminal or axillary, lax, pendent, irregularly branched; branchlets to 2.5 cm long, bearing to 7 flowers. *Flower* white; *buds* to 5 by 2 mm, lanceolate; 2 longer *sepals* lanceolate, subacute; 3 shorter *sepals* broad at base, prominently slender acuminate; *stamens* 25, subequal; filaments somewhat shorter than anthers, filiform; anthers broadly oblong, somewhat tapering; appendage very slender, c. 3 times as long as anthers; *stylopodium* broadly



Fig. 30. *Anisoptera grossivenia* SLOOT. a. End of twig, b. single leaf, c. fruit, d. nut, all  $\times \frac{1}{2}$  (a S 5819, b-d S 6514).

ellipsoid-cylindrical, densely gold puberulent, surmounted by the short but prominent trifid style. *Fruit* pedicel to 3 by 2 mm, expanding into calyx tube; calyx tube to 14 mm  $\varnothing$ , subglobose; 2 longer lobes to 10.5 by 1.8 cm, spatulate, obtuse, c. 5 mm broad at base; 3 shorter lobes to 20 by 3 mm, linear-lanceolate, acute.

Distr. *Malesia*: Malaya (commonest in north), Sumatra (P. Singkep).

Ecol. Mixed Dipterocarp forest on well drained periodically dry soils, especially coastal hills and inland ridges to 700 m.

Vern. *Měrsawa kuning*, *rengkong* (Malaya); *kěruing kutjing*, *měrsawa* (Singkep).

Note. Closely related to *A. costata*; some collections from N.W. Malaya suggest occasional hybridisation.

**3. *Anisoptera costata* KORTH.** Kruidk. (1841) 67, t. 6, f. 1-9; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 42; MIQ. Fl. Ind. Bat. 1, 2 (1859) 501; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 615; PIERRE in Lanessan, Pl. Util. Colon. Fr. (1886) 298; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 43; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 60; J. Str. Br. R. As. Soc. 54 (1910) 25, *p.p.*; Fl. Mal. Pen. 1 (1922) 218, *p.p.*; MERR. En. Born. (1921)

400; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1926) 7, f. 1; Reinwardtia 2 (1952) 8, f. 1, *p.p.*; THORENAAR, Med. Proefst. Boschw. 16 (1926) 106; HEYNE, Nutt. Pl. ed. 2 (1927) 1098; Foxw. Mal. For. Rec. 3 (1927) 79; *ibid.* 10 (1932) 97; Sym. Gard. Bull. S. S. 8 (1934) 9, pl. 3A; Mal. For Rec. 16 (1943) 204, f. 100A, 101; WYATT-SMITH, Mal. For. 18 (1955) 74; BACKER & BAKH, f. Fl. Java 1 (1963) 330; ASHTON, Man. Dipt. Brun. (1964) 11, f. 5, pl. 4 (stem); Gard. Bull. Sing. 31 (1978) 13. — *Dryobalanops hallii* KORTH. msc. in BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220, 243, *nomen in syn.* — *Dipterocarpus parallelus* KORTH. ex BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220, 243. — *A. oblonga* DYER, Fl. Br. Ind. 1 (1874) 301; PIERRE, Fl. For. Coch. 3 (1889) t. 235, 236; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 42; Ind. Trees (1906) 67; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 369; GAMBLE, Man. Ind. Timb. (1922) 75; Sym. Gard. Bull. S. S. 8 (1934) 10, pl. 3B; Mal. For. Rec. 16 (1943) 208, f. 101; PARKINSON, Ind. For. Rec. 20 (1935) 7. — *Shorea nervosa* KURZ [Rep. Pegu App. A (1875) XVIII, *nomen*] Fl. Burma 1 (1877) 119. — *A. cochinchinensis* PIERRE in Lanessan, Pl. Util. Colon. Fr. (1886) 268; Fl. For. Coch. 3 (1889) t. 235A, 253; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 42; HEIM, Bot. Tidsskr. 25 (1902) 44; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 367; CRAIB, Fl. Siam. Enum. 1 (1925) 139; LECOMTE,



Bois Indochine (1926) 115. — *A. robusta* PIERRE, Fl. For. Coch. 3 (1889) t. 236; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 42; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 368; CRAIB, Fl. Siam. Enum. 1 (1925) 140; SYM. Gard. Bull. S. S. 8 (1934) 11. — *A. glabra* (non KURZ) PIERRE, Fl. For. Coch. 3 (1889) t. 235B; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 361 (fig.), 369. — *A. marginatoides* HEIM, Bot. Tidsskr. 25 (1902) 44; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 369; CRAIB, Fl. Siam. Enum. 1 (1925) 139. — *A. mindanensis* Foxw. Philip. J. Sc. 13 (1918) Bot. 181; *ibid.* 67 (1938) 266; MERR. En. Philip. 3 (1923) 92. — Fig. 27A–A4.

Twig of variable thickness, at first frequently angular, becoming minutely striated or smooth, terete. *Bud* 3–5 by 1.5–3 mm, ovoid, somewhat compressed, acute. *Stipule* c. 8 by 3 mm, hastate, acute, fugaceous. *Leaves* 6–18 by 7–11 cm, thin, coriaceous, frequently slightly bullate, oblong to obovate, undersurface grey-green lepidote to golden or chocolate; base obtuse or broadly cuneate; acumen to 5 mm long; margin not revolute or only slightly so; nerves 8–22 pairs, at 60°–70°; *petiole* 2–4 cm long. *Panicle* to 20 cm long, terminal or axillary, angular, pendent, doubly or trebly branched, branchlets bearing up to 5 flowers; *bracteoles* to 4 by 2 mm, hastate, acute, shortly densely pubescent. *Flower bud* to 12 by 6 mm, ovoid, acute. *Calyx* densely tomentose outside, shortly pubescent within; lobes deltoid, ± acute, acuminate, of varying lengths. *Corolla* cream; petals broadly hastate, acute, shortly puberulent on parts exposed in bud. *Stamens* c. 25 (to 35 outside Malesia), subequal; filaments short, compressed; anther oblong, tapering apically; appendage to connective about twice as long as anther, filiform, tapering, reaching almost to apex of stylopodium. *Stylopodium* cylindrical, somewhat tapering, densely pubescent; style short, trifid, pubescent at base, otherwise glabrous. *Fruit calyx* shortly pubescent, tube glabrescent; tube to 1 by 1.2 cm, globose, tapering gradually to the pedicel, narrowed to 8 mm  $\varnothing$  at the neck; 2 longer calyx lobes to 16 by 1.5–2 cm, spatulate, obtuse, c. 5 mm broad at base; 3 shorter lobes to 20 by 4 mm, variable, hastate, base slightly constricted. *Nut apex* broadly conical, crowned by a c. 2.5 by 1.5 mm oblong stylopodium, shortly pubescent.

Distr. Burma, Thailand, Cambodia, Cochinchina, and in *Malesia*: Malaya, Sumatra, W. Java (one record), Borneo (S.E. Kalimantan, Sabah, Brunei, N.E. Sarawak), Philippines (Mindanao, one record).

Ecol. Common, often gregarious, in Semi-evergreen Dipterocarp forest and evergreen forest in seasonal areas; rare but widespread in lowland forest in everwet areas, to 700 m.

Vern. *Mērsawa*, *m. kēsāt*, *m. tērbak*, *tērbak*, *mēr-anti tērbak*, *pokok pahit* (Malaya), *masēgar*, *tēnan*, *mēluwang tikus* (Sumatra), *kētimpun*, *laripung*, *damar tingkis* (Kalimantan).

Notes. A very variable species; forms vary from epilose (*A. mindanensis* Foxw.) to densely pilose (*A. robusta* PIERRE), another has relatively small few-nerved leaves (*Anisoptera* sp. *A.* of Malayan literature).

As now understood, *A. costata* is distinguished by its 25 stamens and generally grey-pubescent leaf with generally at least 15 pairs of nerves. It occurs from Mindanao (one definite record) through Borneo, Java, Sumatra, and Malaya to Chittagong, Burma, Thailand and Indochina. In Mindanao it is epilose but for petals and ovary; in Borneo it has relatively small, chartaceous, sparsely grey-brown pubescent leaves with 15–20 pairs of nerves; in Java, Sumatra and sometimes Malaya the leaves are similar but somewhat larger, with 22 pairs of nerves. In Malaya the species becomes more variable however, usually being relatively large-leaved, with a rather dense, often golden tomentum; in the northwest a small, golden-tomentose leaved form prevails with as few as 8 pairs of nerves. In the Indochinese region the species varies much in leaf size and tomentum, and in more seasonal areas becomes shortly deciduous. No clear geographical differentiation is discernible, though variation is greatest in southern Indochina. In summary, variation appears on the whole as continuous as in a panmictic population, with geographically localised forms appearing in the less seasonal areas.

There is a possibility of hybridisation with *A. curtisii* in N.W. Malaya, and with *A. megistocarpa* in Johore and Singapore (large-leaved golden tomentose forms).

VAN SLOOTEN (1952) recorded *A. costata* from Celebes and the Moluccas on the basis of sterile material. It is indistinguishable from *A. thurifera* (BLCO) BL. when sterile; for phytogeographical reasons I would prefer to tentatively associate these numbers with the latter species.

4. *Anisoptera grossivenia* SLOOT. Bull. Jard. Bot. Btzig III, 16 (1940) 431, f. 1; WYATT-SMITH, Mal. For. 18 (1955) 75; BROWNE, For. Trees Sarawak & Brunei (1955) 93; ASHTON, Gard. Bull. Sing. 20 (1963) 232; Man. Dipt. Brun. (1964) 12, f. 5, pl. 3 (habit); *ibid.* Suppl. (1968) 5; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 296, f. 50. — *A. curtisii* (non DYER ex KING) MERR. En. Born. (1921) 400, *p.p.*, *quoad spec. Born.*; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1926) 11, *p.p.*, *quoad spec. Born.* — *Anisoptera* sp. 'B' WYATT-SMITH, Mal. For. 18 (1955) 79. — Fig. 30.

Leaf nervation beneath, petiole, stipule (outside, shortly pubescent within), leaf bud, panicle and twigs persistently rufous scabrid tomentose; lamina beneath densely rich golden-yellow lepidote. *Twig* to 2 mm  $\varnothing$  apically, terete or ± compressed, rugose when dry, becoming minutely striated. *Bud* 3–5 by 2.5 mm, ovoid, ± compressed. *Stipule* c. 8 by 2.5 mm, hastate, acute, fugaceous. *Leaves* 9–12 by 3–5 cm, oblong to narrowly obovate, slightly bullate; base cuneate; margin slightly recurved; acumen to 1 cm long, narrow; nerves 18–28 pairs, dense, arched, at 60°–70°; tertiary nerves conspicuous, semi-reticulate; looped intramarginal nerve c. 1 mm from margin; *petiole* 2–2.5 cm long, geniculate. *Panicle* to 20 cm long, terminal or axillary; slender, lax, pendent, angular; regularly doubly branched, branchlets lax, to 5 cm

long, bearing up to 8 flowers; *bracteoles* fugaceous. *Bud* to 5 by 2.5 mm, lanceolate, acute. *Calyx* densely rust-brown tomentose, cupped at the base; sepals imbricate, acuminate; 2 inner sepals slightly longer, broader, obtuse; 3 outer acute. *Corolla* magenta at first, becoming rich yellow on opening; petals lanceolate, acute, shortly pubescent on parts exposed in bud. *Stamens* c. 36; filaments slender, short; anthers subglobose; appendage to connective c.  $3 \times$  length of anther, reaching  $\frac{3}{4}$  height of stylopodium, slender. *Ovary* half enclosed in calyx; stylopodium subcylindrical, tapering apically, densely shortly gold-brown tomentose; style short, glabrous; stigma minute. *Fruit calyx* sparsely puberulent; tube to 1.3 cm  $\varnothing$ , globose, hardly constricted at the neck; two longer calyx lobes to 20 by 2.5 cm, narrowly spatulate, obtuse, rarely acute, to 5 mm broad at base; 3 shorter lobes of varying length, occasionally to 6 by 0.4 cm, acute, linear. *Nut* apex obtuse, with c. 8 mm long, c. 15 mm  $\varnothing$ , acute oblong-ovoid stylopodium broadening into the nut at the base; shortly densely rufous pubescent.

Distr. *Malesia*: Borneo (S., S.E. & W. Kalimantan, Sarawak, Brunei, S.W. Sabah).

Ecol. Lowland Dipterocarp forest on sandy soil, on present or Pleistocene coastal hills.

Vern. *Mĕrsawa*, *m. durian* (Mal.), *bĕnchaloi* (Brun.), *pĕngiran kĕsar* (Sabah), *bĕrbakau*, *mĕrbani*, *pĕnyau kĕrabak*, *p. rĕbong*, *p. batu*, *rĕsak tĕmbaga*, *kĕlassih*, *kĕpitun*, *ampereng*, *marlangat*, *chĕngal padi*.

**5. *Anisoptera megistocarpa* SLOOT.** Bull. Jard. Bot. Btżg III, 8 (1926) 12, f. 2; HOLTUM, Gard. Bull. S. S. 5 (1931) 184; Foxw. Mal. For. Rec. 10 (1932) 98; Sym. Gard. Bull. S. S. 8 (1934) 14, pl. 4A; Mal. For. Rec. 16 (1943) 207, f. 101; BURK. Dict. (1935) 164. — *A. costata* (non KORTH.) RIDL. J. Str. Br. R. As. Soc. 54 (1910) 25, *p.p.*; Fl. Mal. Pen. 1 (1922) 218, *p.p.*; BURK. J. Str. Br. R. As. Soc. 75 (1917) 43.

Tall buttressed tree. Twigs, leaf bud, stipule outside, petiole, nervation beneath, panicle, flower calyx and ovary densely persistently dark ferruginous scabrid pubescent; lamina beneath dark golden brown lepidote. *Twig* c. 5 by 3 mm  $\varnothing$  apically, stout,  $\pm$  compressed, rugose, becoming dark brown verrucose. *Buds* to 8 by 5 mm, ovoid; *stipules* to 12 by 6 mm, fugaceous. *Leaves* (5.5–)9–20 by (2.5–)3.5–8 cm, narrowly oblong-elliptic to oblanceolate, thickly coriaceous; margin subrevolute; base obtuse; acumens to 1 cm long, tapering, downcurved; nerves 23–33 pairs, dense, spreading, with short secondary nerves, slender but prominent beneath, distinctly depressed above as also the midrib and subreticulate tertiaries; *petiole* 2–2.8 cm long, to 3 mm  $\varnothing$ , stout. *Panicle* to 12 cm long, terminal or axillary, pendent, irregularly laterally branched; branchlets to 3.5 cm long, bearing to 5 flowers. *Flower* white; *buds* to 8 by 3 mm, lanceolate; 2 longer *sepals* lanceolate, subacuminate; 3 shorter sepals narrowly deltoid, subcaudate. *Stamens* c. 60, subequal; filaments shorter than anther, filiform; anthers oblong, attenuate; appendages filiform, twice length of anthers. *Stylopodium* stoutly ovoid, pubes-

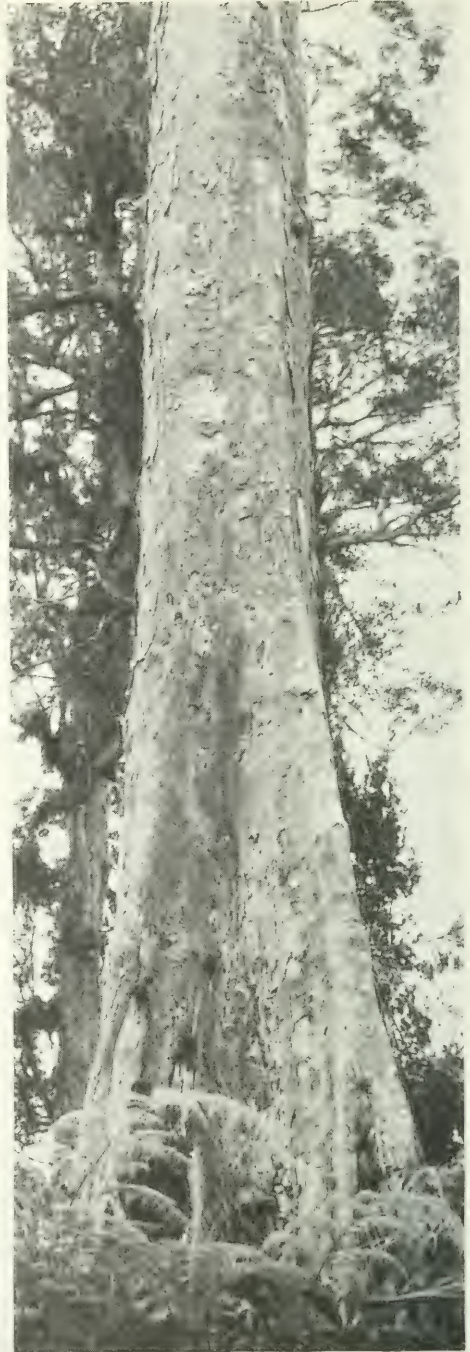


Fig. 31. Trunk-base of *Anisoptera thurifera* (BLCO) BL. Sogeri, Papua (Photogr. ASHTON, Aug. 1970).



cent, surmounted by a short but distinctly trifid style. *Fruit pedicel* to 3 by 2 mm. *Calyx tube* to 2 cm  $\varnothing$ , globose; 2 longer lobes to 22 by 3.8 cm, spatulate, obtuse. *c.* 6 mm wide at the base; 3 shorter lobes to 30 by 3 mm, linear.

Distr. Peninsular Thailand, and in *Malesia*: Malaya (south from Perak and Pahang), Sumatra (Langsa, Atjeh).

Ecol. Scattered in Mixed Dipterocarp forest on undulating land and low hills.

Vern. *Měrsawa mērah*, *m. api*, *sēpah petri* (Malaya); *beurmen* (Sumatra, Atjeh).

**6. *Anisoptera reticulata*** ASHTON, Gard. Bull. Sing. 22 (1967) 260, pl. 1; Man. Dipt. Brun. Suppl. (1968) 5, f. 1.

Leaf, buds, and twig fugaceous golden puberulent. *Twig c.* 2 mm  $\varnothing$  apically, terete, rugulose, dark chocolate-brown; internodes *c.* 1.5 cm long; stipule scar short, horizontal. *Leaf bud* 2 by 2 mm, ovoid, subacute. *Stipule* unknown. *Leaf* 4.5–13 by 2.2–5.5 cm, elliptic-obovate, coriaceous; base broadly cuneate; apex tapering abruptly to a *c.* 5 mm long, short acuminate; nerves 9–14 pairs, prominent beneath, arched, at 50°–55°; tertiary nerves subreticulate; midrib applanate or somewhat depressed above, prominent beneath. *Petiole* 15–35 mm long, *c.* 2 mm  $\varnothing$ , terete, prominently geniculate and swollen distally, drying black. *Panicle* to 6 cm long, 2 mm  $\varnothing$  at base (in fruit); terminal or axillary, short, terete,  $\pm$  persistently golden pubescent, singly branched. *Bud* to 8 by 3 mm, fusiform. *Calyx* lobes narrowly deltoid, unequal, valvate. *Petals* cream, lorate, pubescent on parts exposed in bud. *Stamens c.* 35, subequal; filaments short, compressed; anthers oblong, attenuate; appendage to connective filiform. *Stylopodium* oblong, obtuse, pubescent. *Fruit pedicel* 4 mm long, *c.* 3 mm  $\varnothing$ , stout, prominent. *Calyx* sparsely caducous golden pubescent; tube to 2 cm  $\varnothing$ , subglobose; 2 longer calyx lobes to 13 by 3 cm, lorate-spatulate, obtuse, tapering to *c.* 9 mm broad above the tube; 3 shorter lobes to 20 by 3 mm, linear-lanceolate, acute. *Nut apex* densely persistently yellow-brown pubescent, crowned by a *c.* 4 mm long, 3 mm  $\varnothing$ , oblong obtuse pubescent stylopodium.

Distr. *Malesia*: Borneo (N.E. Sarawak, Brunei, S.W. Sabah).

Ecol. Rare, Mixed Dipterocarp forests on sandy soils.

**7. *Anisoptera thurifera*** (BLCO) BL. Mus. Bot. Lugd.-Bat. 2 (1852) 42; WALP. Ann. 4 (1857) 336; DC. Prod. 16, 2 (1868) 615; VIDAL, Sinopsis (1883) t. 14, f. E; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 44, t. 2, f. 28; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 258; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 115; MERRITT, For. Bur. Bull. Philip. 8 (1908) 48; WHITFORD, Philip. J. Sc. 4 (1910) Bot. 703; For. Bur. Bull. Philip. 10 (1911) 78; Foxw. Philip. J. Sc. 6 (1911) Bot. 256; *ibid.* 13 (1918) Bot. 181; *ibid.* 67 (1938) 267; MERR. Sp. Blanc. (1918) 269; En. Philip. 3 (1923) 92; REYES, Philip. J. Sc. 22 (1923) 323; SLOOT. Bull. Jard.

Bot. Btztg III, 8 (1926) 4; SYM. Gard. Bull. S. S. 8 (1934) 6, pl. 4C; ASHTON, Gard. Bull. Sing. 31 (1978) 15. — *Mocanera thurifera* BLCO, Fl. Filip. ed. 1 (1837) 446. — *Dipterocarpus thurifer* BLCO, Fl. Filip. ed. 2 (1845) 310; *ibid.* ed. 3, 2 (1878) 212, t. 264; DC. Prod. 16, 2 (1868) 614. — **Fig. 27B–B4, 31.**

Notes. *A. thurifera* is now seen to be the eastern analogue of *A. costata*, with a distribution — if sterile collections from Celebes and the Moluccas are included — from northern Luzon throughout the Philippines to Celebes, the Moluccas and New Guinea. In the Philippines geographically defined variation occurs and a separate species has evolved within the aseasional parts of its range. In New Guinea local variation is great and collections are presently inadequate to define geographical forms.

It is interesting that the species is known in both the Philippines and New Guinea to be the only dipterocarp which readily reinvades cultivated land.

I recognize the Philippine and New Guinea populations as geographical subspecies.

#### KEY TO THE SUBSPECIES

1. Leaves oblanceolate to lanceolate, prominently acuminate. Stamens 35–47 . . . ***a. ssp. thurifera***
1. Leaves obovate. Stamens 37–57

#### ***b. ssp. polyandra***

***a. ssp. thurifera*.** — *Mocanera thurifera* BLCO, Fl. Filip. ed. 1 (1837) 446. — *Mocanera mayapis* BLCO, l.c. 449. — *Dipterocarpus thurifer* BLCO, Fl. Filip. ed. 2 (1845) 310. — *Dipterocarpus mayapis* BLCO, Fl. Filip. ed. 2 (1845) 313; DC. Prod. 16, 2 (1868) 610; DYER, J. Bot. 12 (1847) 108; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 40; MERR. Publ. Gov. Lab. Philip. 27 (1905) 21. — *Antherotriche lanceolata* TURCZ. Bull. Soc. Nat. Mosc. 2 (1846) 515; WALP. Ann. 1 (1848) 113. — *A. lanceolata* WALP. Ann. 1 (1848) 113; DC. Prod. 16, 2 (1868) 616; VIDAL, Phan. Cuming. (1885) 97; F.-VILL. Nov. App. (1880) 20; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 263, fig.; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 259, t. 112. — *Shorea mayapis* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 33; WALP. Ann. 4 (1857) 338; DC. Prod. 16, 2 (1868) 632. — *A. oblonga* (non DYER) F.-VILL. Nov. App. (1880) 20; VIDAL, Rev. Fl. Vasc. Filip. (1886) 60. — *Dipterocarpus turbinatus* (non GAERTN. f.) F.-VILL. Nov. App. (1880) 20. — *A. vidaliana* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 44; PERK. Fragm. Fl. Philip. (1904) 23; MERR. Philip. J. Sc. 1 (1906) Suppl. 97. — *A. tomentosa* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 45. — *A. calophylla* PERK. Fragm. Fl. Philip. (1904) 22. — *A. brunnea* Foxw. Philip. J. Sc. 6 (1911) Bot. 254, pl. 40; *ibid.* 13 (1918) Bot. 181; *ibid.* 67 (1938) 270; MERR. En. Philip. 3 (1923) 92.

Tall or medium-sized, buttressed tree. Twigs, leaf buds, stipules, petioles and leaves beneath  $\pm$  densely persistently grey-green or pale to chocolate-brown lepidote; panicles, flower calyx and ovary densely grey-brown puberulent; panicle and calyx becoming

sparse or glabrescent in fruit. *Twig* c. 3 mm  $\varnothing$  apically, terete, rugulose, pale brown. *Leaf bud* to 4 by 2 mm, lanceolate; *stipules* to 8 mm long, linear. *Leaves* 6–15 by 2.5–6.5 cm, thinly coriaceous, elliptic to lanceolate or obovate-ob lanceolate,  $\pm$  coriaceous; base broadly cuneate or obtuse; acumen to 1.3 cm long, slender, down-curved and twisting over on pressing; nerves (12–)14–18(–20) pairs, slender but distinctly elevated beneath, less so above (as also the reticulate tertiary nerves), arched, at 55°–80°, with or without short secondary nerves; midrib prominent beneath, obscure, depressed, above; *petiole* 1.7–3.5 cm long, slender. *Panicles* to 20 cm long, terminal or subterminal axillary, lax, pendent; singly branched, branchlets bearing to 11 flowers. *Flower buds* to 9 by 3 mm, lanceolate. *Sepals* narrowly deltoid; 2 longer subacute, 3 shorter prominently acuminate. *Stamens* 45–47, subequal; filaments short, slender, filiform; anthers narrowly oblong, somewhat tapering; appendages very slender,  $\pm$  twice length of anthers. *Stylopodium* narrowly ellipsoid-cylindrical, puberulent distally, with prominent trifid style. *Fruit pedicel* to 3 mm long, short. *Calyx tube* to 17 mm  $\varnothing$ , globose; 2 longer lobes to 15 by 1.5 cm, spatulate, narrowly obtuse, c. 4 mm wide at base; 3 shorter lobes to 30 by 3 mm, linear. *Stylopodium* short, conical.

Distr. *Malesia*: Philippines.

Ecol. Evergreen and Semi-evergreen Dipterocarp forests below 750 m; common and often gregarious, regenerating in secondary forest.

Vern. *Mayapis*, *palosapis*, *palohapi*, *dagang*, *afu*.

**b. ssp. polyandra** (BL.) ASHTON, Gard. Bull. Sing. 31 (1978) 16. — *A. polyandra* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 42, t. 6; WALP. Ann. 4 (1857) 335; MIQ. Fl. Ind. Bat. 1, 2 (1859) 501; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 84; DC. Prod. 16, 2 (1868) 615; SCHEFF. Ann. Jard. Bot. Btzig 1 (1876) 9; F.v.M. Descr. Not. App. 6 (1887) 97; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 45; DIELS, Bot. Jahrb. 57 (1922) 461; LANE-POOLE, For. Res. (1925) 22, 33, 119, 167; SLOOT, Nova Guinea 14 (1926) 222; Bull. Jard. Bot. Btzig III, 8 (1926) 15; Reinwardtia 2 (1952) 11, f. 2; WHITE & FRANCIS, Proc. R. Soc. Queensl. 38 (1927) 247. — *Dipterocarpus parviflora* ZIPP. Flora 12 (1829) 281; Alg. Konst- & Letterbode 1, 19 (1829) 296; Bijdr. Natuurk. Wet. 5 (1830) 178; MIQ. Fl. Ind. Bat. 1, 2 (1859) 501, *nomen*. — *Dipterocarpus microcarpus* ZIPP. ex MIQ. Fl. Ind. Bat. 1, 2 (1859) 501, *nomen in syn.* — *Anisoptera* sp. DYER, J. Bot. 16 (1878) 99; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 221; BRANDIS, J. Linn. Soc. Bot. 3 (1895) 45; DIELS, Bot. Jahrb. 57 (1922) 461. — *A. forbesii* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 45; DIELS, Bot. Jahrb. 57 (1922) 491; BAKER f. J. Bot. 61, Suppl. (1923) 5. — *A. kostermansiana* DILMY, Reinwardtia 3 (1956) 347; *ibid.* 5 (1960) 267.

Differing as follows: *Leaves* 8.5–18 by 3.5–8.5 cm, elliptic to obovate,  $\pm$  coriaceous; base cuneate, obtuse or cordate; apex shortly acuminate; nerves (10–)12–14(–17) pairs, slender but distinctly elevated

on both surfaces. *Stamens* 37–57. *Fruit* pedicel to 4 by 2 mm, prominent; 2 longer calyx lobes to 7 by 0.6 cm; 2 shorter lobes to 7 by 0.6 cm.

Distr: *Malesia*: New Guinea, and possibly (sterile material) from Celebes and Moluccas (Morotai, Halmahera, Batjan, Obi and Aru Is.).

Ecol. Common, often gregarious, in lowland forest on undulating land and hills to 600 m, especially on sedimentary rocks and along ridges; regenerates profusely in secondary forest.

Vern. *Baoti*, *tolu* (Celebes), *bolam*, *kora*, *hate besi* (Morotai), *kara*, *hirus*, *kopodaka*, *owiru*, *kako* (Halmahera), *damar utan*, *d. hiru*, *asamban*, *gawi*, *wewe pērēnpuan* (Batjan), *kora* (Obi), *jamar*, *doka* (Aru), *aran marei*, *wuku*, *taire*, *damar papan*, *taai*, *baurai*, *maniori*, *armanuri*, *kansiopi*, *ansiopi*, *merait*, *kandau*, *karalaka*, *garawa*, *karawa*, *warawa*, *balia*, *ordima*, *barida* (New Guinea).

Note. This species is extremely variable, paralleling *A. costata* (g.v.). The range of variation in tomentum is comparable in both species.

**8. Anisoptera aurea** FOXW. Philip. J. Sc. 67 (1938) 271, pl. 1–2. — *A. curtisii* (non DYER ex KING) FOXW. Philip. J. Sc. 6 (1911) Bot. 255, pl. 41; *ibid.* 13 (1918) Bot. 181; WHITFORD, Bull. Bur. For. Philip. 10 (1911) 78; MERR. En. Philip. 3 (1923) 92; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1926) 11; SYM. Gard. Bull. S. S. 8 (1934) 17.

Large tree with pale shaggily flaky bark. Leaf undersurface densely golden lepidote; nerves and midrib beneath, leaf buds, petiole, twigs and ovary densely persistently pale brown puberulent; panicles and fruit calyx sparsely so; parts of petals exposed in bud densely greyish puberulent. *Twigs* c. 3 mm  $\varnothing$ , becoming terete, pale brown, rugulose. *Leaf buds* to 4 by 2 mm, lanceolate, acute; *stipules* not seen. *Leaves* 7–11 by 2.5–5.5 cm, oblong or oblanceolate, thinly coriaceous; base cuneate or sometimes obtuse; acumen to 1 cm long, slender, prominent, down-curved and bending over on pressing; nerves (15–)18–20 pairs, slender but distinctly elevated beneath, less so but distinct above, at 65°–80°; secondary nerves obscure or absent; tertiary nerves densely reticulate, evident on both surfaces; midrib slender but prominent beneath, obscure, deeply depressed, above; petioles 15–27 mm long, slender, prominently geniculate. *Panicles* to 12 cm long, slender, lax, pendent, terminal or axillary, singly (if axillary) or doubly branched; branchlets to 15 mm long, bearing to 3 flowers. *Flower buds* to 6 by 3 mm. *Sepals* narrowly deltoid, 2 longer subacute, 3 shorter prominently acuminate; *stamens* 35–38, subequal; filaments  $\pm$  equal to the oblong somewhat tapering anthers, filiform; appendage very slender, c.  $\frac{1}{3}$  times as long as anthers; *stylopodium* broadly ellipsoid-cylindrical, densely golden stellate-puberulent, crowned by the prominently trifid acute style. *Fruit pedicel* to 4 mm long, slender; *calyx tube* to 7 mm  $\varnothing$  subglobose; 2 longer lobes to 10 by 1.5 cm, narrowly spatulate, narrowly obtuse, c. 3 mm wide at base; 3



shorter lobes to 12 by 2 mm, linear; *stylopodium* cylindric, tapering, subacute.

Distr. *Malesia*: Philippines (Luzon: Quezon; Camarines: Polillo).

Ecol. Mixed Dipterocarp forest, especially on ridges to 200 m, in everwet zone.

Vern. *Dugong, manapo, malahapi, dagong* (Laguna).

## 2. Section *Glabrae*

HEIM, Rech. Dipt. (1892) 33; SYM. Gard. Bull. S. S. 8 (1934) 1; Mal. For. Rec. 16 (1943) 199; ASHTON, Gard. Bull. Sing. 20 (1963) 232; Man. Dipt. Brun. (1963) 10. — *Scaphula* PARKER in Fedde, Rep. 3 (1932) 326. — *Hopeoides* CRETZOIU, J. Jap. Bot. 17 (1941) 408.

Young leaves and twigs epilose. Flower buds globose; anthers linear; appendage to connective less than  $\frac{1}{2}$  length of anther, stout; *stylopodium* a flattened discoid platform surmounting the ovary; style filiform, long, with distinct trifid stigma.

9. *Anisoptera scaphula* (ROXB.) KURZ, Fl. Burma 1 (1877) 547, 2 (1877) 586; PIERRE, Fl. For. Coch. 3 (1889) sub t. 235; SYM. Gard. Bull. S. S. 8 (1934) 2, 4, pl. 1; Mal. For. Rec. 16 (1943) 209, f. 101, 104. — *Hopea scaphula* ROXB. [Hort. Beng. (1814) 93, *nomen*] Fl. Ind. ed. Carey 2 (1932) 611; WALP. Rep. 5 (1845) 128; DC. Prod. 16, 2 (1868) 635; KURZ, Prelim. Rep. For. Pegu (1875) App. A, 19, App. B, 29; Fl. Burma 1 (1877) 121, 547. — *A. glabra* KURZ, J. R. As. Soc. Beng. Sc. 52, 2 (1873) 61; Prelim. Rep. For. Pegu (1875) App. A, 16, App. B, 29; Fl. Burma 1 (1877) 112; DYER, Fl. Br. Ind. 1 (1874) 301; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 41; Ind. Trees (1906) 67, t. 29; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 368. — *Vatica scaphula* DYER, Fl. Br. Ind. 1 (1874) 301; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 127; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 132; Ind. Trees (1906) 72; GAMBLE, Man. Ind. Timbers (1922) 84. — *A. thurifera* (non BL.) RIDL. Fl. Mal. Pen. 1 (1922) 219; FOXW. J. Mal. Br. R. As. Soc. 5 (1927) 341, *p.p.*; Mal. For. Rec. 3 (1927) 78, *p.p.*; *ibid.* 10 (1932) 100. — *Scaphula glabra* PARKER in Fedde, Rep. 30 (1932) 326; CRETZOIU, Act. Faun. Flor. Univ. Bot. 1, 9 (1933) 3; PARKINSON, Ind. For. Rec. 20, 15 (1935) 11. — *Hopeoides scaphula* CRETZOIU, J. Jap. Bot. 17 (1941) 408.

Very tall buttressed tree. Parts glabrous but for the greyish green lepidote leaf undersurface and young parts. *Twig* c. 2 mm  $\varnothing$  apically, slender, pale grey-brown, terete. *Buds* to 2 by 2 mm, small, acute; *stipules* to 20 by 3 mm, linear, acute. *Leaf* 8–16 by 3.5–8 cm, oblong-lanceolate to oblanceolate, somewhat chartaceous; base broadly cuneate to subcordate; acumen to 1 cm long, tapering; nerves 13–18 pairs, very slender, arched, ascending, elevated on both surfaces as also the very slender subreticulate tertiaries, with a few short secondary nerves; midrib slender but prominent, terete, beneath, channelled above; *petiole* 12–32 mm long, slender. *Panicle* to 9 cm long, terminal or axillary. *Flower* white; *buds* to 6 by 5 mm, broadly ovoid. 2 longer *sepals* lorate-lanceolate, subacute; 3 shorter *sepals* very short, deltoid, prominently slender acuminate. *Petals* broadly ovate, glabrous. *Stamens* 15; filaments lorate, tapering, c.  $\frac{1}{2}$  length of the slightly

tapering lorate anthers; appendages very short, acicular. *Stylopodium* absent; style prominent, columnar, glabrous, with obscurely trifid apex. *Fruit pedicel* to 3 by 2 mm, prominent. *Calyx* tube to 1.5 mm  $\varnothing$ , subglobose; 2 longer lobes to 15 by 3 cm, spatulate, obtuse, c. 4 mm broad at base; 3 shorter lobes to 13 by 3 mm, linear-lanceolate.

Distr. Southern Indochina, Bangladesh (Chittagong), Burma, Peninsular Thailand, and in *Malesia*: Malaya (north of Negri Sembilan and Pahang).

Ecol. Semi-evergreen and Evergreen Dipterocarp forests on undulating land and the lower parts of valleys.

Vern. *Měrsawa gajah, sanai, tērbak, mēdang sawa, kijal* (Malaya).

10. *Anisoptera laevis* RIDL. Fl. Mal. Pen. 1 (1922) 219; FOXW. Mal. For. Rec. 10 (1932) 101; SYM. Gard. Bull. S. S. 8 (1934) 7, pl. 2; Mal. For. Rec. 16 (1943) 205, f. 100C, 101, 102; ASHTON, Gard. Bull. Sing. 20 (1963) 233; Man. Dipt. Brun. (1964) 13, f. 5, pl. 5 (stem); *ibid.* Suppl. (1968) 5; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 298, f. 51. — *Anisoptera* sp. BRANDIS, J. Linn. Soc. Bot. 31 (1895) 41 (sub *A. glabra*). — *A. glabra* (non KURZ) RIDL. Agr. Bull. Str. & F. M. S. 1 (1901) 60; J. Str. Br. R. As. Soc. 54 (1910) 25. — *A. thurifera* (non BL.) FOXW. Philip. J. Sc. 6 (1911) Bot. 257, *p.p.*, *quoad* sp. Mal.; J. Mal. Br. R. As. Soc. 5 (1927) 341, *p.p.*; Mal. For. Rec. 3 (1927) 78, *p.p.* — *A. mindanensis* (non FOXW.) WYATT-SMITH, Mal. For. 18 (1955) 77, *p.p.* — Fig. 27C–C4.

Bud and twig apex  $\pm$  densely pale brown to rust lepidote at first, becoming glabrous. *Young twig* c. 1.5 mm  $\varnothing$ , slender, terete, becoming rugose on drying; later smooth or minutely striated. *Bud* 3–7 by 2 mm, compressed, hastate to ovate, acute. *Stipule* c. 10 by 3 mm, glabrous, hastate to linear. *Leaves* 7–11 by 3–4 cm, oblong to  $\pm$  obovate, not bullate, epilose, rust-brown lepidote beneath; base obtuse or broadly cuneate; acumen to 1 cm long; nerves 10–14 pairs, at 50°–60°, slender, curved; *petiole* 1.5–2 cm long. *Panicle* to 12 cm long, terminal or axillary, lax, pendent, angular, slender, densely shortly pale brown puber-



Fig. 32. *Upuna borneensis* SYM., *upun batu*, habit, about 40 m tall. Brunei, Labi Road (Photogr. ASHTON).





Fig. 33. *Upuna borneensis* SYM. *a.* Apex of flowering twig, *b.* fruit, *c.* nut, all  $\times \frac{1}{2}$  (SAN 15184).

lent to glabrous; alternately doubly branched, branchlets short, bearing to 11 flowers; *bracteoles* to 2.5 mm long, lanceolate, shortly pubescent. *Bud* to 2 mm long, subglobose. *Calyx* cupped at base; sepals subequal, valvate, shortly grey-brown puberulent outside; 2 longer lobes slightly broader, obtuse, 3 shorter acute, acuminate. *Petals* small, elliptic-oblong, glabrous, pale yellow. *Stamens* 15, subequal, as long as or slightly longer than the style; filaments short, tapering to the anther; anther narrowly oblong, the inner cells smaller than the outer; appendage to connective short, erect. *Ovary* encased in the base of the calyx, covered by a discoid stylopodium, crowned by a filiform

glabrous style; stigma 3-lobed. *Fruit calyx* glabrous at maturity; tube 1.2–1.5 cm  $\varnothing$ , globose, to 8 mm  $\varnothing$  at the neck; 2 longer lobes to 15 by 1.5 cm, spatulate, obtuse, *c.* 5 mm broad at base; 3 short lobes to 1.5 cm long, *c.* 3 mm broad at base, hastate to linear, margin slightly revolute. *Nut apex* disc-like, shortly pubescent, flat; style remnant 5–8 mm long, filiform, very slender.

*Distr. Malesia:* Malaya, Borneo (Sarawak, Brunei, S.W. Sabah).

*Ecol.* Inland lowland and hill forests to 900 m: widespread and often common.

*Vern.* *Mersawa durian*, *mëdang sawa*, *madang loh* (Mal.), *pëngiran durian* (Sabah).

### 3. UPUNA

SYM. Bull. Jard. Bot. Btzg III, 17 (1941) 88, pl. I–II. f. I–II. — **Fig. 32–36.**

Large, flaky-barked trees. *Buttresses* low, broad, rounded, single or grouped in twos to fours round the base of the bole. Young parts caducous, inflorescence persistently multicellular glandular tomentose. *Stipule* subulate, subpersistent. *Inflorescence* cymose. *Flower sepals* subequal, imbricate, fused at the base to form a shallow cup free from the ovary. *Stamens* 25–30; filaments compressed, dilated at base, tapering and filiform below the anthers; anthers oblong to ovoid, latrorse; appendage to connective filiform, many times length of anthers. *Ovary* ovoid, without distinct stylopodium; style about twice as long as ovary, trifid towards

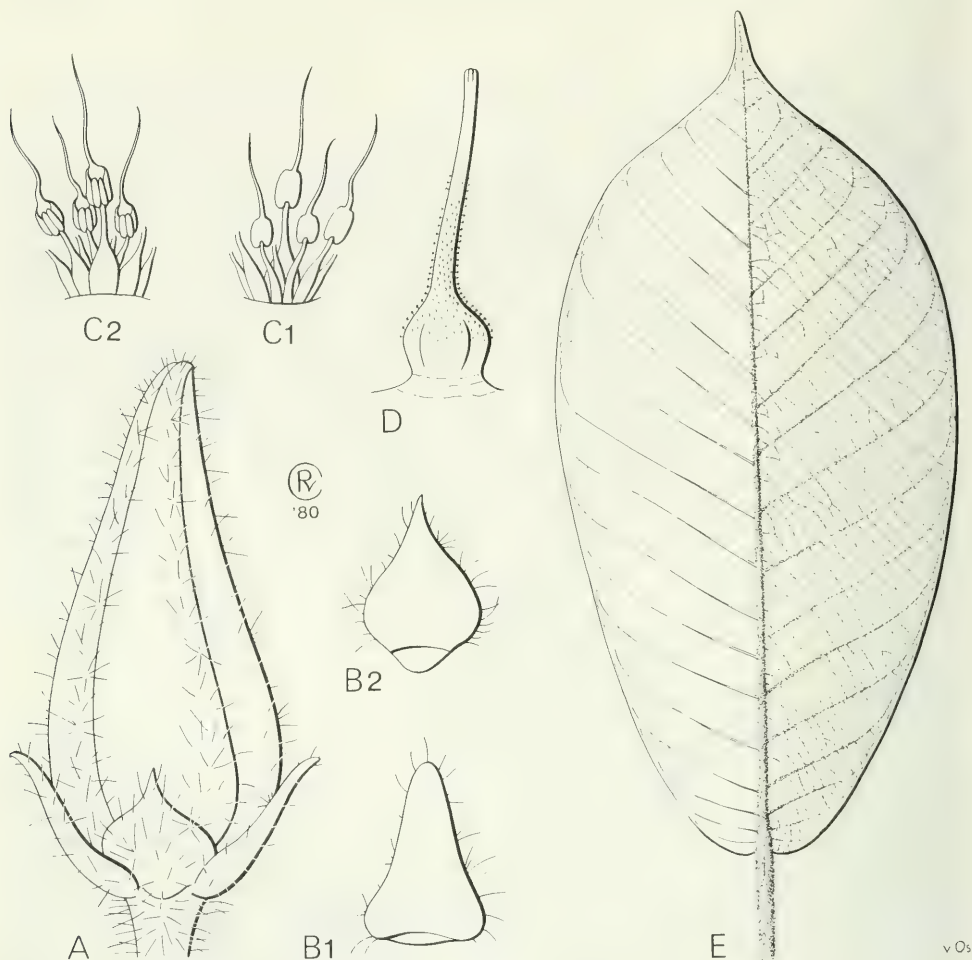


Fig. 34. *Upuna borneensis* SYM. Flower details: A. bud, B1. outer sepal, B2. inner sepal, both from inside, C1. stamens from outside, C2. Stamens from inside, D. pistil, all  $\times 10$ . — E. Leaf from sterile twig,  $\times \frac{1}{2}$  (A–D BRUN 3091, E SINCLAIR & KADIM 10292).

apex; stigma minute. *Fruit calyx* with a distinct basal cup enclosing but not fused with the nut; lobes valvate, chartaceous, 2 considerably longer than the other 3. *Nut* ellipsoid, 3-angled, splitting into 3 valves at germination, with short acute apical style remnant, tapering and narrow at base. *Seed* with distinct arillode. *Germination* epigeal; cotyledons subequal, cordate.

Distr. *Malesia*: Borneo. Monotypic.

Note. The only dipterocaroid genus not recorded from the present or past of S.E. Asia including Ceylon. An isolated and in many ways primitive taxon, with leaves and twigs superficially resembling *Monotes*, dehiscent pericarp and cymose inflorescence as in some *Vatica*, a rudimentary aril-like collar on the funicle resembling that in *Stemonoporus*, androecium somewhat as in *Anisoptera* and gynoecium somewhat as in *Cotylelobium*, though the gynoecium and androecium characters together are unique among those genera which share a valvate fruit calyx. The wood anatomy, notably the diffuse distribution of intercellular canals, supports its affinity with the last four genera.



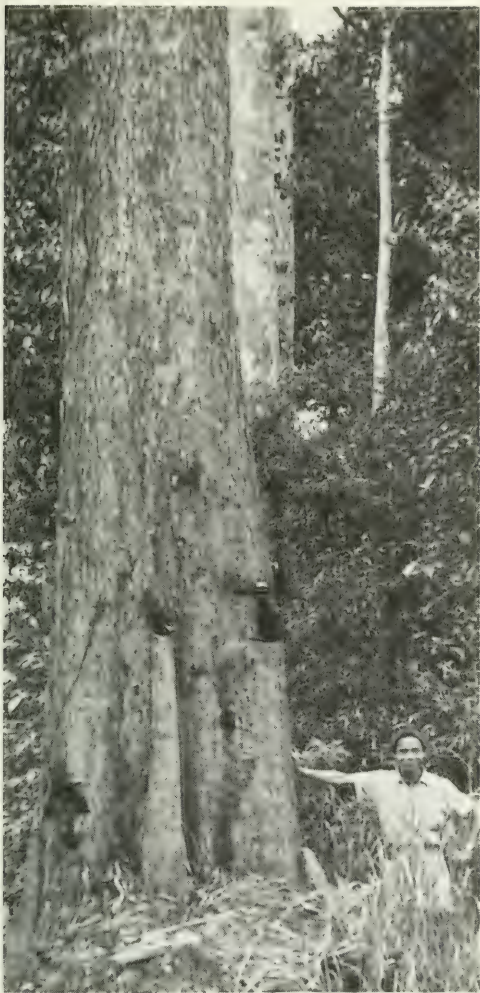


Fig. 35. Trunk-base of *Upuna borneensis* SYM., same place as fig. 32 (Photogr. ASHTON).



Fig. 36. Young, conical tree of *Upuna borneensis* SYM. Forest Research Institute, Kepong, cultivated (Photogr. HENDERSON).

1. *Upuna borneensis* SYM. Bull. Bot. Gard. Btzig III, 17 (1941) 88, pl. I-II, f. I-II; BROWNE, For. Trees Sarawak & Brunei (1955) 171; ASHTON, Man. Dipt. Brun. (1964) 7, f. 4, pl. 2 (habit); *ibid.* Suppl. (1968) 3; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 327. — Fig. 32–36.

Young parts caducous multicellular glandular tomentose; twig apices, cyme, leaf bud, stipule, petiole and leaf nervation beneath densely persistently pale chocolate-brown tomentose; lamina surface beneath white tomentose. Twig to 3.5 mm  $\varnothing$  apically, terete, becoming glabrous, smooth to rugulose, uneven; much branched; stipule scars small to obscure. Bud to

12 by 6 mm, ovoid to falcate, subacute. Stipules to 1.2 cm long, linear. Leaves 9–17 by 4–9.5 cm, oblong to obovate; base cordate, acumen to 5 mm long, deltoid; margin revolute; nerves 16–20 pairs, well spaced, curved at the margin, raised beneath, at 60°–70° except at base, frequently with short secondary nerves; tertiary nerves well spaced, scalariform, distinct; midrib prominent, terete beneath, depressed above; petiole 1–2.5 cm long, geniculate. Cyme to 15 cm long, to 3-axillary, subterete, much branched; bracts to 10 by 3.5 mm, lanceolate, acute, sparsely tomentose, caducous. Flower bud to 5 by 2 mm, narrowly ovoid, conical, acute. Calyx lobes densely tomentose outside, glabrescent within, fused at base forming a cup free from the ovary, imbricate; subequal, 2 inner slightly more attenuate, obtuse, subacuminate; 3 outer acute, acuminate. Corolla deep purple, dark yellow at margins, fading to pale red on falling; petals broadly ovate, subacute, becoming reflexed apically, sparsely tomentose on parts exposed in bud. Stamens 25–30 in several verticils; filaments broad at base, tapering abruptly and filiform below the subglobose anthers; appendage to connective c. 3 times length of anther, slender, curved. Ovary ovoid, densely tomentose; style c. 3 times as long as ovary,

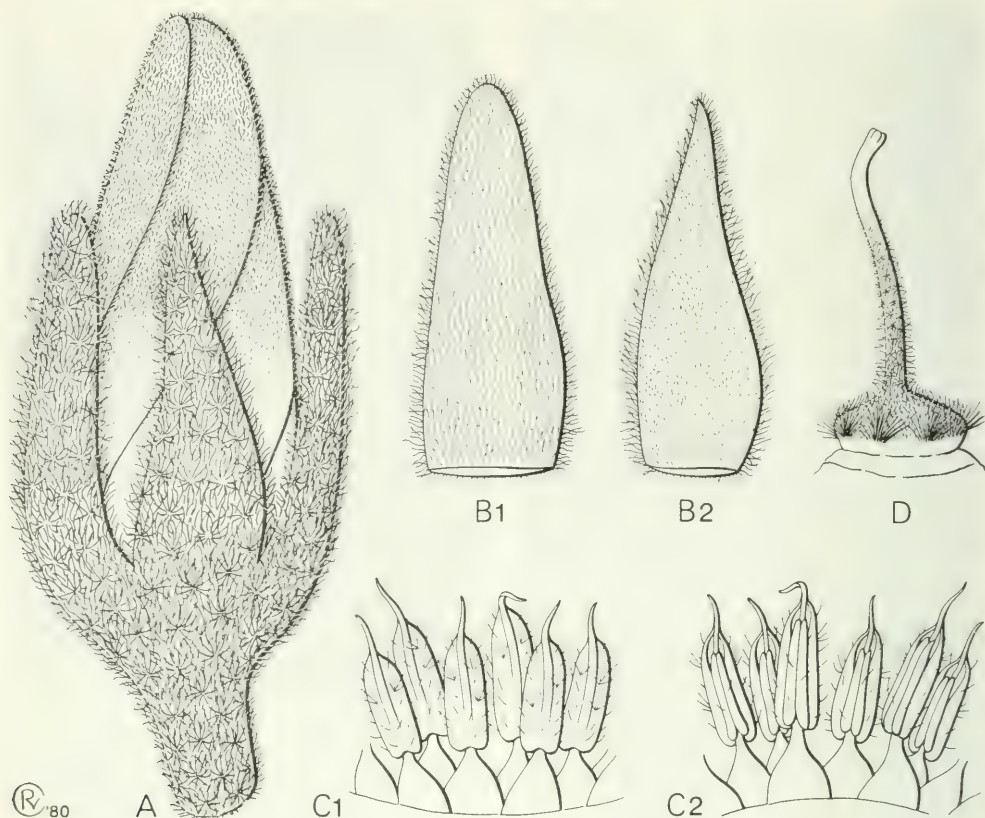


Fig. 37. Flower details in *Cotylelobium melanoxylon* (HOOK. f.) PIERRE. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C1. stamens from outside, C2. stamens from inside, D. pistil, all x10 (S 26853).

shortly pubescent in basal half, otherwise glabrous, sometimes trifurcate at apex. *Fruit calyx* sparsely ashen tomentose; base narrowly cuneate, the lobes united into a to 1 cm deep and wide cup; 2 longer lobes to 13 by 2.7 cm, lanceolate, tapering gradually to the subacute apex, constricted to 7 mm broad at base; 3 shorter lobes to 7.5 by 1.7 cm, similarly shaped, subequal. *Nut* to 3.2 by 1.5 cm, narrowly ovoid,

densely fulvous tomentose, tapering to a to 5 mm long slender style remnant, acute.

*Distr. Malesia:* Borneo (S. & W. Kalimantan, E. Kutei F. R.; Sarawak, Brunei, S.W. Sabah).

*Ecol.* Deep sandy soil in lowland Mixed Dipterocarp forests, subcoastal hills.

*Uses.* Heavy construction timber.

*Vern.* Pénau, upun batu.

#### 4. COTYLELOBIUM

PIERRE, Fl. For. Coch. 3 (1889) *sub* t. 235; HEIM, Rech. Dipt. (1892) 119; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 114; SLOOT, Bull. Jard. Bot. Btzg III, 10 (1929) 393; *ibid.* III, 12 (1932) 43; SYM. Mal. For. Rec. 16 (1943) 232, f. 111 (map); ASHTON, Man. Dipt. Brun. (1964) 56; *ibid.* Suppl. (1968) 24; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 323; ASHTON, Blumea 20 (1972) 358; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 23. — *Dyerella* HEIM, Rech. Dipt. (1892) 123. — **Fig. 37–40.**



Small, medium-sized or large trees; bole frequently twisted; buttresses low, rounded, similar to those of *Vatica*. Crown hemispherical, rather small. *Bark surface* greyish, at first smooth, hoop marked; becoming irregularly, frequently shaggy, flaky, leaving a distinct scroll-marked surface below. *Stipules* fugaceous. *Leaves* oblong to ovate-lanceolate, coriaceous, margin revolute, undersurface lepidote; nerves curved, unraised above, hardly so beneath, bifurcating towards the margin and anastomosing to form a looped intramarginal nerve, with shorter indistinct intermediate nerves similarly bifurcating; tertiary nerves reticulate, indistinct; midrib sunken above; *petiole* comparatively short, not geniculate. *Calyx lobes* imbricate in flower; 2 obtuse outer lobes somewhat larger than 3 acute inner lobes. *Petals* free, broad, elliptic-oblong, cream or pink. *Stamens* 15, subequal, in 3 whorls, hence pairs alternating with single stamens; filaments short, deltoid, connate at base; anthers narrowly oblong, latrorse, with 4 pollen sacs, the inner 2 shorter than the outer 2, setose along the lateral margins; appendage to connective short, slender. *Ovary* free from calyx,  $\pm$  globose; stylopodium indistinct; style filiform, slender, many times longer than ovary, shortly pubescent towards base; stigma small, trifid, slightly broader than style. *Fruit* as in *sect. Sunapteia* of *Vatica*; calyx free from nut, with distinct filiform style remnant.

Distr. 6 spp., Ceylon, Peninsular Thailand; in *Malesia*: 3 spp., in Malaya, E. Sumatra, Lingga, Anambas Is. and Borneo. Fig. 38.

Ecol. Main canopy trees of dry acid soils, especially on coastal hills, but also on rentzinas over limestone and mountain ridges inland to 1500 m; sometimes semi-gregarious.

Uses. A hard durable timber similar to that of *Vatica* is produced, but the trees are generally larger.

Note. The perianth and range of fruit variation strikingly resemble that of *Vatica*, and the wood anatomy underlines this affinity; but the androecium, gynoecium and leaf nervation are quite distinct from that genus. The Malesian species differ only in characters of the tomentum, and minor details of leaf shape and nervation; they are variable and at times difficult to identify with certainty; the possibility of occasional hybridisation cannot be ruled out.

#### KEY TO THE SPECIES

1. Leaf glabrescent, drying dull olive-brown . . . . . 1. *C. melanoxylo*
1. Leaf densely tomentose beneath.
  2. Leaf 8–12 by 3–4.5 cm, oblong-lanceolate, drying dull olive-brown above, densely shortly evenly rich yellow-ochre tomentose beneath, with darker midrib and petiole; intramarginal nerve close to margin . . . . . 2. *C. burckii*
  2. Leaf 6–8 by 2.2–3 cm, ovate-lanceolate, drying dark grey-brown above, densely dark grey scabrid tomentose beneath with darker midrib and petiole; intramarginal nerve well within margin . . . . . 3. *C. lanceolatum*

1. *Cotylelobium melanoxylo* (HOOK. f.) PIERRE, Fl. For. Coch. 3 (1889) t. 235; HEIM, Rech. Dipt. (1892) 119, 120; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 268; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 115; MERR. En. Born. (1921) 408; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 78; *ibid.* 10 (1929) 403; *ibid.* 12 (1932) 44; SYM. Mal. For. Rec. 16 (1943) 236, f. 114; BROWNE, For. Trees Sarawak & Brunei (1955) 96; ASHTON, Man. Dipt. Brun. (1964) 59, f. 9; *ibid.* Suppl. (1968) 24, pl. 5 (bark); MEIJER & WOOD, Sabah For. Rec. 5 (1964) 324, f. 59. — *Anisoptera melanoxylo* HOOK. f. Trans. Linn. Soc. 23 (1860) 160; DC. Prod. 16, 2 (1868) 616; WALP. Ann. 7 (1869) 378; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 221. — *Vatica melano-*

*xylo* BENTH. & HOOK. f. ex MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 956, *incl. var. recta*. — *Vatica beccariana* HEIM, l.c. 955. — *Vatica harmandii* HEIM, l.c. 955. — *C. beccarii* PIERRE, Fl. For. Coch. 4 (1891) t. 258B; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 116; BECC. For. Born. (1902) 570, 591; MERR. En. Born. (1921) 408; BROWNE, For. Trees Sarawak & Brunei (1955) 95. — *C. harmandii* HEIM, Rech. Dipt. (1892) 122; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 115; MERR. En. Born. (1921) 408; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 78; *ibid.* 10 (1929) 405; BROWNE, For. Trees Sarawak & Brunei (1955) 95. — *C. beccarianum* HEIM, Rech. Dipt. (1892) 122; SLOOT. Bull. Jard. Bot. Btzg

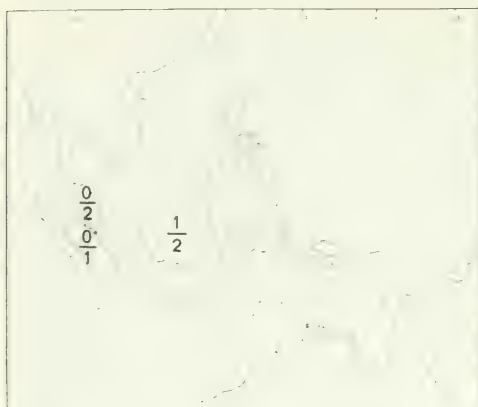


Fig. 38. Density map of *Cotylelobium* PIERRE in Malesia; number of endemics above the hyphen, number of non-endemics below it.

III, 9 (1927) 78; *ibid.* 10 (1929) 405. — *C. leucocarpum* SLOOT. [Bull. Jard. Bot. Btzig III, 9 (1927) 78, *nomen*] *ibid.* III, 10 (1929) 399, f. 2. — *Vatica leucocarpa* FOXW. *ex* DEN BERGER & ENDERT. Med. Proefst. Boschw. 11 (1925) 130; *ex* HEYNE, Nutt. Pl. ed. 2 (1927) 1129. — Fig. 37, 39.

Young leaves, twig, stipules outside, bud and raceme densely shortly powdery grey tomentose, fugaceous on leaf and midrib,  $\pm$  so on twigs, persistent on racemes. *Twig* to 1 mm  $\varnothing$  apically, terete, slender, minutely striated with fine cracks; stipule scars obscure. *Bud* c. 1.5 by 1 mm, ovoid, acute. *Stipules* to 3 mm long, small, linear, caducous. *Leaves* 5–10 by 2–6 cm, ovate-lanceolate, oblong or obovate; base broadly cuneate or obtuse; acumens to 8 mm; margin  $\pm$  revolute; nerves 10–13 pairs, slender, hardly raised beneath, with more slender shorter parallel intermediates; intramarginal nerve strongly looped, c. 2 mm within the margin; *petiole* 9–12 mm long. *Panicle* to 8 mm long, axillary, slender, singly branched; *bracts* and *bracteoles* to 10 by 3 mm, lanceolate, acute, shortly pubescent outside, glabrescent within. *Flower bud* to 6 by 3 mm, ellipsoid, obtuse. *Calyx* densely pubescent outside, sparsely so within; lobes subequal, narrowly deltoid, acute. *Petals* narrowly ovate, obtuse, sparsely pubescent on parts exposed in bud. *Stamens* 15, subequal; filaments linear, tapering, c. 3 times as long as the anther, half as long as the style, sparsely ciliate along lateral margins; appendage to connective c.  $\frac{1}{4}$  as long as the anther, short, slender. *Ovary* ovoid, densely pubescent; style filiform, slender, c. 3 times as long as the ovary, pubescent towards base, otherwise glabrous. *Fruit calyx* persistently pubescent towards base, glabrescent elsewhere; 2 longer lobes to 4.5 by 1.2 cm, oblong, obtuse, c. 2 mm broad at base; 3 shorter lobes 8–14 by 2–3 mm, hastate, acute, fimbriate; lobes united at base

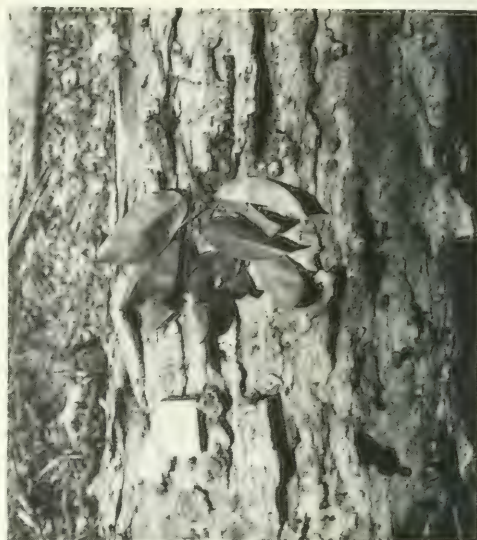


Fig. 39. Close-up of bark and leaves of *Cotylelobium melanoxylon* (HOOK. f.) PIERRE. Brunei (Photogr. G. H. S. WOOD, SAN 17547).

into a shallow cup c. 8 mm  $\varnothing$ . *Nut* c. 6 mm long and broad, ovoid, with up to 5 mm long style remnant, shortly pale buff tomentose.

*Distr.* Coastal Peninsular Thailand; in *Malesia*: S. Malaya (N.E. Johore), Singapore, Sumatra (Singkep, Lingga; Central Sumatra: Siak, Indragiri; P. Musala), Borneo.

*Ecol.* Local, on dry, often sandy soils on coastal hills and terraces, sometimes in secondary forest.

*Vern.* *Resak*, *r. hitam* (Brunei), *r. tēmpurong* (Sabah), *r. bukit*, *r. tēmbaga* (Lingga), *r. batu*, *r. tēmbaga*, *r. padi*, *r. kēranji* (W. Borneo), *r. bunga* (E. Borneo).

*Note.* The species, especially *C. malayanum*, are somewhat variable and the possibility of hybridisation between *C. malayanum* and *C. melanoxylon* cannot be excluded.

**2. *Cotylelobium burckii* (HEIM) HEIM, Rech. Dipt.** (1892) 122; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 78; ASHTON, Gard. Bull. Sing. 20 (1963) 243; Man. Dipt. Brun. (1964) 57, f. 9, pl. 20–21 (habit, stem); *ibid.* Suppl. (1968) 24. — *Vatica burckii* HEIM, Bull. Mens. Soc. Linn. Paris 2 (July 1891) 956. — *C. flavum* PIERRE, Fl. For. Coch. 4 (Oct. 1891) t. 258A; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 115, t. 3, f. 22–24; BOERL. Cat. Hort. Bog. 2 (1901) 112; BECC. For. Born. (1902) 570; MERR. En. Born. (1921) 408; SLOOT. Bull. Jard. Bot. Btzig III, 12 (1932) 44; SYM. Gard. Bull. S. S. 8 (1934) 36; BROWNE, For. Trees Sarawak & Brunei (1955) 171; ANDERSON, Gard. Bull. Sing. 20 (1963)





Fig. 40. *Cotylelobium lanceolatum* CRAIB. **a.** Flowering twig,  $\times 2/3$ . — *C. burckii* (HEIM) HEIM. **b.** Fruiting twig,  $\times 2/3$ , **c.** fruit, **d.** nut, both  $\times 2$ , **e.** leaf from sterile twig,  $\times 2/3$  (*a* S 28068, *b* S 12995, *c-d* KEP 32615, *e* bb. 15334).

157. — *C. asperum* SLOOT. Bull. Jard. Bot. Btzg III, 10 (1929) 401, f. 3; *ibid.* 12 (1932) 1. — **Fig. 40b-e.**

Twig, bud, petiole, stipules outside, midrib beneath and raceme densely shortly persistently buff tomentose, slightly scabrid; leaf evenly densely ochereous tomentose beneath. Twig *c.* 1.5 mm  $\varnothing$  apically, slender, smooth. Bud 1.5–2 by 1.5 mm, small. Stipules to 8 mm long, narrowly deltoid, fugaceous. Leaves 8–12 by 3–4.5 cm, oblong-lanceolate; margin prominently revolute; base broadly cuneate or obtuse; acumen 2.5–7.5 mm long; nerves 10–12 pairs, indistinct, the intramarginal nerve comparatively straight and just within the margin; petiole 1.5–2 cm long. Panicle to 15 cm long; to 3-axillary, rarely terminal, terete or ribbed, irregularly doubly branched; bracteoles to 8 by 5 mm, elliptic, obtuse, shortly buff pubescent. Flower bud to 10 by 4 mm, ovoid-lanceolate, acute. 2 calyx lobes long, linear, obtuse; 3 short, lanceolate, acute; densely buff tomentose outside, more sparsely within. Corolla cream; petals large, narrowly oblong, obtuse, glabrous. Stamens 15, the inner 5 slightly longer than the others; filaments short, broad at base, strongly tapering; anthers narrowly

oblong, reaching half length of style, with sparsely setose lateral margins; appendage to connective  $\frac{1}{2}$  as long as anther, slender. Ovary subglobose, densely tomentose; style slender, 3–4 times as long as ovary, shortly pubescent but for the glabrous apical  $\frac{1}{4}$ . Fruit calyx as in *C. melanoxylon* but base more densely tomentose, longer lobes *c.* 1.5 cm broad, persistently shortly sparsely tomentose; 3 shorter lobes to 1.2 cm long, linear, shortly sparsely tomentose on both surfaces. Nut as in other species.

Distr. *Malesia*: Borneo (W. Kutei, Lower Dayak, W. Borneo, Sarawak and Brunei N.E. to the Limbang).

Ecol. Locally common on giant podsols, on raised beaches, rare on sandstone cuestas, near present and Pleistocene coastlines.

Vern. *Rēsak durian*, *r. babalok*, *r. gunong*, *r. baru*.

**3. *Cotylelobium lanceolatum* CRAIB**, Kew Bull. (1913) 113; Fl. Siam. Enum. 1 (1925) 142. — *C. malayanum* SLOOT. Bull. Jard. Bot. Btzg III, 12 (1932) 43; Foxw. Mal. For. Rec. 10 (1932) 247; BURK. Dict. (1935) 673; SYM. Gard. Bull. S. S. 9 (1938) 349; Mal. For. Rec. 16



Fig. 41. *Vatica umbonata* (HOOK. f.) BURCK. a. Habit,  $\times \frac{1}{2}$ , b-c. young fruits,  $\times \frac{1}{2}$ , d. ripe fruit, lateral view, e. ditto, apical view, both nat. size (a SAN 68373, flowers from SAN 15367, b A 4743, c FRI 12496, d-e BRUN 933).



(1943) 235, f. 113, 114; BROWNE, For. Trees Sarawak & Brunei (1955) 95; ASHTON, Man. Dipt. Brun. (1964) 11, f. 9; *ibid.* Suppl. (1968) 24, pl. 4 (bark); MEIJER, Sabah For. Rec. 5 (1964) 324. — *C. flavum* (non PIERRE) RIDL. J. Str. Br. R. As. Soc. 54 (1909) 25; Fl. Mal. Pen. 1 (1922) 239; SLOOT. Bull. Jard. Bot. Btzg III, 10 (1929) 396, f. 1, *specim.* BECCARI *excl.*; FOXW. Mal. For. Rec. 3 (1928) 71; *ibid.* 10 (1932) 247. — **Fig. 40a.**

Twig, bud, petiole, stipule outside, lamina beneath, and raceme persistently densely grey-brown to rufous scabrid tomentose; tomentum on lamina beneath dotted with scattered darker larger tufts. *Twig* c. 1 mm  $\varnothing$  apically, slender, terete. *Bud* c. 1.5 by 1 mm, small, conical. *Stipules* c. 3 mm long, narrowly deltoid, fugaceous. *Leaves* 6–8 by 2.5–3 cm, narrowly ovate-lanceolate; margin revolute; base broadly cuneate; acumens to 5 mm long; nerves 10–12 pairs, with a prominently looped intra-marginal nerve c. 2 mm from the margin; *petiole* 6–10 mm long, short, slender. *Panicle* to 6 cm long, terminal or axillary, short, terete, ribbed; irregularly singly or doubly branched; *bracteoles* to 4 by 3 mm, elliptic, obtuse, densely shortly

tomentose outside, sparsely so within. *Flower bud* to 8 by 3.5 mm, ovoid, obtuse. *Calyx* densely buff-tawny tomentose outside, sparsely so within, lobes subequal, deltoid, short; outer slightly narrower, more acute. *Corolla* cream; petals short, narrowly oblong, obtuse, glabrous. *Stamens* 15, the inner 5 slightly longer than the rest; filaments short, triangular; anthers narrowly oblong, with prominently setose margin; appendage to connective short, slender. *Ovary* small, subglobose, densely tomentose; style c. 3 times as long as ovary, filiform, pubescent towards base. *Fruit calyx* as in *C. burckii* but more scabrid tomentose; shorter lobes 1.2–2 by 0.4 cm, comparatively long, broadly hastate, constricted at base. *Nut* as in other species.

Distr. Eastern Peninsular Thailand, and *Malesia*: E. Malaya (from Trengganu southwards), Anambas Is., Borneo (W. Borneo, Sarawak, Brunei, S.W. & S.E. Sabah, Kutei, lower Mahakam), erroneously recorded from Sumatra by SYMINGTON (1938).

Ecol. Locally abundant, podsolised soils in Heath forest on terraces and sandstone ridges to 1500 m; on peaty soils over limestone in W. Sarawak.

Vern. *Resak*, *r. batu*, *r. bukit* (Mal.).

## 5. VATICA

LINNÉ, Mant. 2 (1771) 152; B. & H. Gen. Pl. 1 (1862) 192, *incl. sect. Isauxis* (ARN.) B. & H.; DC. Prod. 16, 2 (1868) 517; DYER, Fl. Br. Ind. 1 (1874) 301; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 223, *incl. sect. Sunaptea* (GRIFF.) BURCK *et sect. Pachynocarpus* (HOOK. f.) BURCK, l.c. 225; HEIM, Rech. Dipt. (1892) 99; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 268; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 116, *incl. subg. Synaptea* (GRIFF.) BRANDIS, l.c. 128, *subg. Retinodendron* (KORTH.) BRANDIS, l.c. 119, *subg. Isauxis* (ARN.) BRANDIS, l.c. 127; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 67; FOXW. Philip. J. Sc. 67 (1938) 319; SYM. Mal. For. Rec. 16 (1943) 211, f. 105 (map); ASHTON, Gard. Bull. Sing. 20 (1963) 243; Man. Dipt. Brun. (1964) 61; *ibid.* Suppl. (1968) 25; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 301; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 81. — *Seidlia* KOSTEL. Allg. Med.-Pharm. Fl. 5 (1836) 1945. — *Vateria* ARN. Ann. Nat. Hist. 1, 3 (1839) 155, *pro sect. Isauxis* ARN. — *Retinodendron* KORTH. Kruidk. (1840) 55. — *Isauxis* (ARN.) REICHB. Nom. (1841) 210. — *Pteranthera* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 30. — *Sunaptea* GRIFF. Notul. 4 (1854) 516, corr. '*Synaptea*' KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 65. — *Pachynocarpus* HOOK. f. Trans. Linn. Soc. 23 (1860) 159; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 266. — *Elaeogene* MIQ. Sum. (1862) 460. — *Retinodendropsis* HEIM, C. R. Assoc. Fr. Pau 1892 (1893) 470. — *Perissandra* GAGN. Bull. Soc. Bot. Fr. 95 (1948) 27, *cf.* JACOBS, Blumea 15 (1967) 138. — *Brachypodandra* GAGN. l.c. 30. — **Fig. 41–47.**

Small to medium-sized, rarely large, trees; bole frequently sinuate, buttresses thick, rounded, concave, usually small. *Crown* irregular, oblong, sympodial, non-emergent. *Bark surface* usually grey mottled, smooth and hoop-marked, in large trees becoming patchily flaked, occasionally scroll-marked. Young parts usually  $\pm$  caducous powdery tomentose. *Leaves* variable; nerves curved, usually

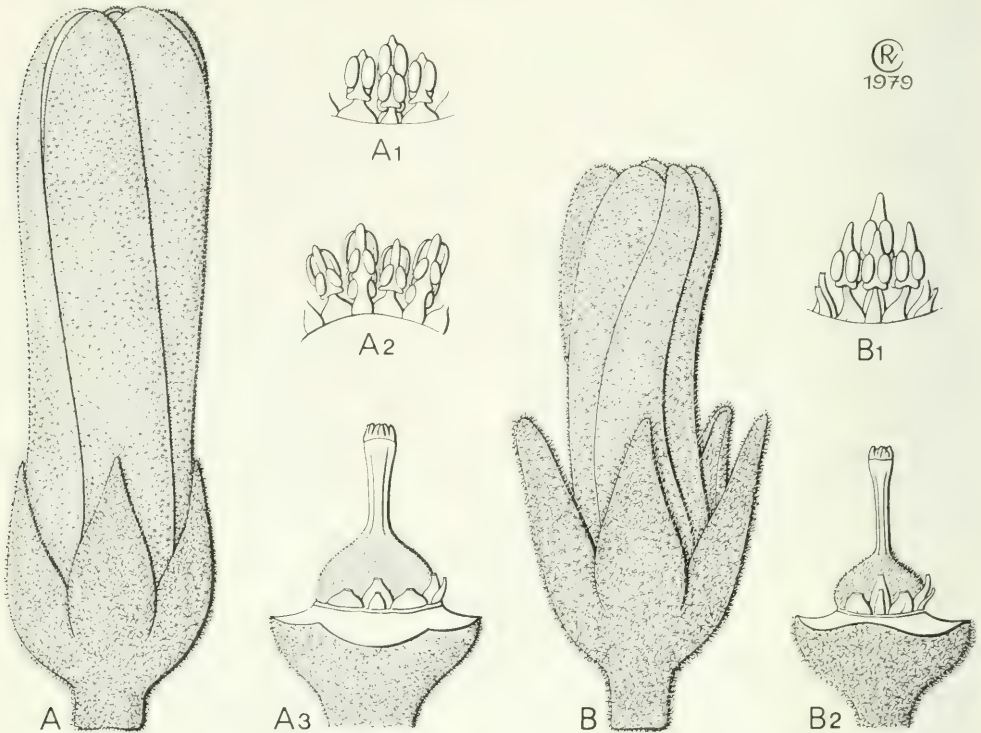


Fig. 42. *Vatica umbonata* (HOOK. f.) BURCK. A. Bud, A1. stamens from outside, A2. stamens from inside, A3. pistil, all  $\times 10$ . — *V. maingayi* DYER. B. Bud, B1. stamens from outside, B2. pistil, all  $\times 10$  (A AMBULLAH 31457. B Neth. Ind. For. Serv. F 922).

somewhat oblique to the midrib; tertiary nerves  $\pm$  reticulate, never truly scalariform; *petioles* not geniculate. *Inflorescences* irregularly branched, racemose or sometimes partially cymose, short, rarely spreading. *Flower buds* ovoid to lanceolate, of variable size. *Calyx lobes*  $\pm$  valvate, subequal. *Petals* narrowly oblong, usually pale cream-white, not connate at base, falling separately. *Stamens* 15 in 3 verticils, single stamens alternating with pairs, short, the inner row slightly longer than the outer row; filaments short, dilated at base,  $\pm$  tapering and filiform below anthers; anthers broadly oblong, latrorse, the inner pollen sacs smaller than the outer; appendage to connective short, rarely as long as anthers,  $\pm$  deltoid, stout. *Ovary*  $\pm$  broadly ovoid, conical, superior or semi-inferior, shortly densely pubescent, without distinct stylopodium; style columnar, short, stout, glabrous, somewhat expanded at apex and with a prominent conical 3-lobed stigma. *Fruit calyx* variable. *Nut* of variable size, broadly ovoid or globose, with or without a distinct apical style remnant; pericarp splitting along 3 sutures at germination; *germination* epigeal (*sect. Sunapteia*; some *sect. Vatica*) or hypogaeal (some *sect. Vatica*) with the cotyledons remaining within the fruit; cotyledons, if free from fruit, magenta to pale yellow, usually non-photosynthe-



tic; first pair of leaves opposite with interpetiolar stipules, rarely alternate; the succeeding leaves spiral.

Distr. About 65 *spp.* in Ceylon and southern and eastern India, Burma, Thailand, Indochina, S. China (Hainan), and c. 55 *spp.* throughout *Malesia* excepting the Lesser Sunda Is. Fig. 43.

Ecol. Understorey trees, sometimes in main canopy, scattered in lowland forests and some species in hill forests to 1600 m; several species semi-gregarious on river-banks.

Uses. A hard semi-durable timber is obtained, but the trees are small; used locally for house posts and other minor construction.

Note. A genus clearly circumscribed by its extraordinary constancy of floral structure and also wood anatomy; its closest affinity is with *Cotylelobium* (*q.v.*). The two main forms of fruit calyx appear to have evolved only once and, judged by the wide geographical distribution of the two sections, would seem to mark an ancient dichotomy in the genus.

#### KEY TO THE SPECIES<sup>1</sup>

1. Fruit calyx lobes equal. *Spp.* 1–24. **1. Sect. *Vatica***
  2. Fruit calyx lobes corky, coalescing with each other and with the nut, forming a cup  $\pm$  enclosing it.
    3. Nut ovoid or globose, not exceeding 2.5 cm long. Petiole to 15 mm long . . . . . **1. *V. umbonata***
    3. Nut to 4 cm long, narrowly ovoid-ellipsoid. Petiole exceeding 18 mm long . . . . . **2. *V. stapfiana***
  2. Calyx lobes not as above.
    4. Calyx lobes in fruit subcordate, somewhat revolute at base, not reflexed,  $\pm$  concealing nut.
      5. Nerves 8–15 pairs, without distinct secondary nerves . . . . . **3. *V. venulosa***
      5. Nerves at least 16 pairs, with distinct secondary nerves.
        6. Twigs, panicles and petiole persistently fulvous  $\pm$  flocculent pubescent . . . . . **4. *V. havilandii***
        6. Twigs and panicles caducous buff puberulent; petiole glabrous. . . . . **5. *V. chartacea***
    4. Calyx lobes not cordate; nut completely exposed.
      7. Nut ovoid, generally coming to exceed 2.3 cm long; pericarp thick, corky verrucose.
        8. Fruit sepals to 5 mm long, broadly ovate to suborbicular, adpressed to the base of the nut.
          9. Nut to 3 by 3 cm, ovoid . . . . . **6. *V. pauciflora***
          9. Nut to 4.5 by 1.8 cm, fusiform . . . . . **7. *V. ridleyana***
        8. Fruit sepals linear-lanceolate.
          10. Fruit sepals patent, becoming recurved and revolute resembling claws . . . . . **8. *V. soepadmoi***
          10. Fruit sepals not as above.
            11. Nut prominently beaked . . . . . **9. *V. bella***
            11. Nut not prominently beaked.
              12. Nut becoming asymmetrical; petiole exceeding 2 cm long . . . . . **10. *V. rassak***
              12. Nut symmetrical; petiole shorter than 2 cm long.
                13. Leaves to 20 by 7 cm; nerves 10–12 pairs . . . . . **11. *V. granulata***
                13. Leaves at least 22 by 7 cm; nerves 15–28 pairs . . . . . **12. *V. sarawakensis***
      7. Nut smooth.
        14. All parts entirely glabrous. . . . . **13. *V. albiramis***
        14. Young parts at least puberulent or pubescent.
          15. Tomentum vinous.
            16. Twigs compressed . . . . . **14. *V. oblongifolia***
            16. Twigs terete.
              17. Calyx lobes thin, hardly revolute . . . . . **15. *V. dulitensis***
              17. Calyx lobes, incrassate, becoming revolute.
                18. Nut 2.2 cm  $\varnothing$  . . . . . **16. *V. pedicellata***
                18. Nut not exceeding 1 cm  $\varnothing$ .
                  19. Nerves 9–11 pairs . . . . . **17. *V. rotata***
                  19. Nerves 12–20 pairs . . . . . **18. *V. vinosa***
        15. Tomentum not vinous.
          20. Tomentum rufous.
            21. Leaves large, oblong, with obtuse or cordate base . . . . . **19. *V. scortechinii***
            21. Leaves medium-sized, obovate, with narrowly cuneate base . . . . . **20. *V. globosa***
          20. Tomentum buff or pale brown.

(1) The following species are not inserted in the key: 52. *V. elliptica*, 53. *V. pentandra*, 54. *V. cauliflora*, 55. *V. glabrata*, and 56. *V. obtusa*.

22. Fruit sepals incrassate, adnate to nut . . . . . 21. *V. lobata*  
 22. Fruit sepals not incrassate, becoming  $\pm$  revolute or reflexed. . . . .  
 23. Stipules large, elliptic, subsistent . . . . . 22. *V. hullettii*  
 23. Stipules minute, fugaceous. . . . .  
 24. Leaves and nut glabrescent . . . . . 23. *V. pallida*  
 24. Leaves beneath and nut persistently pubescent . . . . . 24. *V. flavida*
1. Fruit calyx lobes unequal. *Spp. 25–51. 2. Sect. Sunaptea*  
 25. Fruit calyx lobes fused into a cup at base, adnate to the fruit.  
 26. Nut exceeding 1 cm  $\varnothing$ ; fruit calyx lobes  $\pm$  patent, of varying lengths . . . . . 25. *V. heteroptera*  
 26. Nut at most 8 mm  $\varnothing$ ; calyx with ascending lobes, 2 of which greatly exceed the others.  
 27. Tomentum cream to tawny; twigs  $\pm$  compressed at first.  
 28. Nerves 8–11 pairs . . . . . 26. *V. maritima*  
 28. Nerves 13–17 pairs . . . . . 27. *V. teysmanniana*  
 27. Tomentum not as above; twigs terete.  
 29. Twigs and petioles sparsely pale scurfy . . . . . 28. *V. cinerea*  
 29. Twigs and petioles densely persistently pubescent . . . . . 29. *V. odorata*
25. Fruit calyx lobes free to base.  
 30. Twigs compressed . . . . . 30. *V. compressa*  
 30. Twigs terete or ribbed.  
 31. Leaf obovate, thickly coriaceous, normally obtuse or retuse, margin revolute.  
 32. Inflorescence to 3 cm long, congested. Petiole exceeding 1.2 cm . . . . . 31. *V. congesta*  
 32. Inflorescence to 20 cm long, lax. Petiole less than 1 cm long . . . . . 32. *V. coriacea*
31. Leaf not as above.  
 33. Nerves at least 22 pairs, persistently pubescent beneath . . . . . 33. *V. javanica*  
 33. Nerves less than 22 pairs, or, if 22, then glabrous.  
 34. Leaf nervation beneath pale brown or ocherous pubescent.  
 35. Leaf undersurface persistently shortly buff scabrid pubescent; petiole 8–15 mm long . . . . . 34. *V. brunigii*
35. Leaf beneath (but not nerves) sparsely sericeous, glabrescent; petiole 15–30 mm long.  
 36. Leaf base broadly cuneate. Nerves 10–11 pairs . . . . . 35. *V. pachyphylla*  
 36. Leaf base narrowly obtuse. Nerves 11–14 pairs . . . . . 36. *V. obovata*
34. Leaf nervation glabrescent beneath.  
 37. Nerves hardly more prominent beneath than above.  
 38. Petiole at least 14 mm long.  
 39. Nerves 7–9 pairs; tomentum pink-brown . . . . . 37. *V. borneensis*  
 39. Nerves 9–11 pairs; tomentum ocherous-buff . . . . . 38. *V. bantamensis*
38. Petiole 1 cm long or shorter.  
 40. Ripe nut broadly ovoid, obtuse, densely tomentose.  
 41. Midrib raised above; base of leaf cuneate . . . . . 39. *V. mangachapoi*  
 41. Midrib flat or slightly sunken above; base of leaf obtuse. . . . . 40. *V. parvifolia*  
 40. Ripe nut narrowly ovoid, tapering, acute, glabrous . . . . . 41. *V. rynchocarpa*
37. Nerves distinctly more prominently raised below than above.  
 42. Inflorescence, petiole, nerves and midrib beneath persistently shortly pale brown scabrid tomentose. Leaf thin, obtuse.  
 43. Petiole exceeding 15 mm long . . . . . 42. *V. endertii*  
 43. Petiole at most 11 mm long.  
 44. Leaf elliptic to obovate, base narrowly cuneate . . . . . 43. *V. brevipes*  
 44. Leaf elliptic-oblong to lanceolate, base obtuse . . . . . 44. *V. micrantha*
42. Tomentum not as above, nervation beneath glabrescent. Leaf base generally cuneate.  
 45. Leaf drying yellowish olive, lustrous; tomentum ocherous buff . . . . . 45. *V. flavovirens*  
 45. Leaf drying grey-brown or red-brown; tomentum pink-brown or rufous.  
 46. Tomentum very short, even.  
 47. Petiole at least 2 cm long; longer calyx lobes to 8 by 2.5 cm . . . . . 46. *V. badiifolia*  
 47. Petiole shorter than 2 cm; longer calyx lobes to 6 by 1.8 cm . . . . . 47. *V. perakensis*
46. Tomentum scabrid or flocculent.  
 48. Major fruit calyx lobes coming to exceed 7 cm long.  
 49. Major fruit calyx lobes somewhat broadened at base; leaf nerves 12–22 pairs 48. *V. nitens*  
 49. Major fruit calyx lobes tapering at base; nerves at most 17 pairs.  
 50. Petiole scabrid pubescent; nerves 10–17 pairs. . . . . 49. *V. cuspidata*  
 50. Petiole sparsely puberulent; nerves 9–11 pairs . . . . . 50. *V. maingayi*  
 48. Major fruit calyx lobes less than 6 cm long . . . . . 51. *V. lowii*



1. Section *Vatica*

ASHTON, Gard. Bull. Sing. 20 (1963) 250, incl. sect. *Pachynocarpus* (HOOK. f.) BURCK. — *Seidlia* KOSTEL. — *Vateria* sect. *Isauxis* ARN. — *Retinodendron* KORTH. — *Isauxis* (ARN.) REICHB. — *Pachynocarpus* HOOK. f. *Elaeogene* MIQ. — *Vatica* sect. *Isauxis* (ARN.) B. & H. — *Vatica* sect. *Retinodendron* (KORTH.) BURCK et sect. *Pachynocarpus* (HOOK. f.) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 224. — *Vatica* subg. *Retinodendron* (KORTH.) BRANDIS et subg. *Isauxis* (ARN.) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 119, 127.

Calyx lobes equal.

**1. *Vatica umbonata*** (HOOK. f.) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 232; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 132, 133; ASHTON, Gard. Bull. Sing. 20 (1963) 250; Man. Dipt. Brun. (1964) 78, f. 10; *ibid.* Suppl. (1968) 36; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 320, f. 58, pl. 30A; ASHTON, Gard. Bull. Sing. 31 (1978) 17.

**a. ssp. *umbonata*.** — *Pachynocarpus umbonatus* HOOK. HOOK. f. Trans. Linn. Soc. 23 (1860) 159, t. 22; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 617; WALP. Ann. 7 (1868) 378; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 135, t. 3, f. 25; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 270, fig.; MERR. En. Born. (1921) 409; RIDL. Fl. Mal. Pen. 1 (1922) 249, *p.p.*; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 265. — *V. verrucosa* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 232, t. 29, f. 5; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 131; in MERR. Pl. Elm. Born. (1929) 205; BROWNE, For. Trees Sarawak & Brunei (1955) 102. — *Pachynocarpus verrucosus* HEIM, Rech. Dipt. (1892) 107; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 136; MERR. En. Born. (1921) 410; RIDL. Fl. Mal. Pen. 1 (1922) 249, *p.p.* — *V. blancoana* ELMER, Leaflet. Philip. Bot. 4 (1912) 1473; Foxw. Philip. J. Sc. 13 (1918) Bot. 196; *ibid.* 67 (1938) 326; MERR. En. Philip. 3 (1923) 102. — *V. cupularis* SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 132, t. 13; in MERR. Pl. Elm. Born. (1929) 205, *p.p.*; HEYNE, Nutt. Pl. ed. 2 (1927) 1129; BROWNE, For. Trees Sarawak & Brunei (1955) 100. — *V. ramiflora* SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 118, *p.p.* — *V. stapfiana* (non SLOOT.) BROWNE, For. Trees Sarawak & Brunei (1955) 102. — **Fig. 41, 42A–A3.**

Young twig, raceme, leaf bud, stipule and petiole shortly sparsely pale grey-brown puberulent, persistent only on leaf bud and stipules. Twig to 3 mm  $\varnothing$  apically, stout, brittle, much branched, crooked, covered with small linear striations, cracks and sometimes flakes. Bud to 2 by 1.5 mm, ovoid, subacute. Stipules to 4 by 2 mm, hastate, subacute, early caducous. Leaves 8–16 by 3–6.5 cm, somewhat coriaceous, elliptic; base  $\pm$  broadly cuneate; apex obtuse or shortly acuminate; nerves 7–8 pairs, raised beneath, slightly curved, at 45°–55°; no distinct secondaries; midrib raised beneath,  $\pm$  applanate above. Petioles 7–15 mm long. Panicle to 12 cm long, singly, rarely doubly branched, axillary or terminal, rigid, brittle,

falling apart before maturity. Flower bud to 1 cm long; calyx shortly curved pubescent; flowers typical. Fruit pedicel 2–5 mm long. Nut to 3 cm long and  $\varnothing$ , pink-brown verrucose, compressed at base; calyx united into a tube adpressed to and fused to nut; differentiated into 5, to 2.6 by 1.8 cm, oblong-elliptic, up to 5 mm thick lobes by 5 deep longitudinal furrows; nut 3-sulcate, exposed only at apex.

Distr. *Malesia*: Malaya (Pahang, Trengganu), W. and N. Borneo, S. Philippines (Palawan).

Ecol. Locally abundant, alluvium river-banks; scattered on hillsides, locally frequent on acid soils in mountains at 900–1300 m.

Vern. *Resak ayer*, *r. gunong*, *r. labuan*.

Note. See also under 56. *V. obtusa* BURCK.

**b. ssp. *acrocarpa*** (SLOOT.) ASHTON, Gard. Bull. Sing. 31 (1978) 17. — *V. acrocarpa* SLOOT. Bull. Gard. Btzig III, 17 (1942) 241, f. 31; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 320.

Nut ovoid, acute, the fruit sepals united to basal  $\frac{1}{2}$  only and reflexed.

Distr. *Malesia*: E. Borneo.

Ecol. Apparently always on or near river-banks.

Note. *V. umbonata* is frequently gregarious on river-banks and the continuous variation found in this habitat, especially in N.E. Borneo where the two subspecies occur in the same area and in E. Malaya where the closely related *V. stapfiana* occurs in the same habitat, suggests panmixis and some local hybridisation. Some hybridisation appears to occur with *V. rassak* in E. Sabah.

**2. *Vatica stapfiana*** (KING) SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 129; *ibid.* III, 17 (1941) 137; Foxw. Mal. For. Rec. 10 (1932) 274; BURK. Dict. (1935) 2225; SYM. Mal. For. Rec. 16 (1943) 228, f. 107, 109. — *Pachynocarpus stapfianus* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 136; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 136; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 161, t. 194; BURK. & Foxw. J. Str. Br. R. As. Soc. 86 (1922) 279; RIDL. Fl. Mal. Pen. 1 (1922) 249; CRAIB, Fl. Siam. Enum. 1 (1925) 140. — *Pachynocarpus wallichii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 135, *p.p.*; RIDL. Fl. Mal. Pen. 1 (1922) 250, *p.p.* — *Pachynocarpus grandiflorus* RIDL. J. Fed. Mal. St. Mus. 10, 2 (1920) 127; CRAIB, Fl. Siam. Enum.

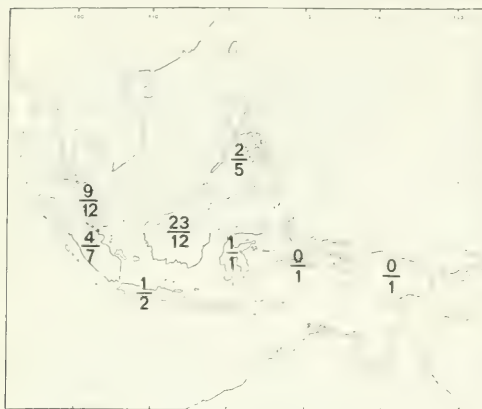


Fig. 43. Density map of *Vatica* L. in Malesia; number of endemics above the hyphen, number of non-endemics below it.

(1925) 140. — *Pachynocarpus umbonatus* (non Hook. f.) RIDL. Fl. Mal. Pen. 1 (1922) 249, p.p. — *Pachynocarpus verrucosus* RIDL. Fl. Mal. Pen. 1 (1922) 249, p.p.

Medium-sized tree. Twigs, petioles, stipules, panicles, calyx outside and ovary  $\pm$  persistently densely scabrid ferruginous puberulent, leaf undersurface sparsely so or glabrescent, parts of petals exposed in bud pale brown puberulent. Twigs 3–4 mm  $\varnothing$ , stout, much branched, ribbed, becoming pale brown, rough. Buds to 3 by 2 mm, linear-lanceolate, acute, caducous. Leaves 12–25 by 5–12 cm, typically elliptic-obovate,  $\pm$  thickly coriaceous; base cuneate; margins  $\pm$  prominently revolute; acumen  $\pm$  abrupt, to 1.5 cm long, prominent; nerves 7–9(–15) pairs, ascending, arched, very stout and prominent beneath, evident above as also the midrib; tertiary nerves subreticulate, distinctly elevated beneath, hardly so above; petiole 1.7–3 cm long, 2–4 mm  $\varnothing$ , stout. Panicle to 10 cm long, terminal or axillary, somewhat congested and irregularly branched. Flower bud to 12 by 3 mm, fusiform; petals pale yellow with a purplish patch at base; staminal appendages c.  $\frac{1}{2}$  length of outer anther cells, broadly deltoid; stigma short, hardly longer than ovary, stout, expanding distally into the conical style; flowers otherwise typical. Fruit subsessile or to 2 mm long pedicellate; calyx lobes equal, to 2.3 by 2.3 cm, ovate, acute, united except at the apex and fused with the to 4 by 2.5 cm ovoid apiculate protruding verrucose corky pericarp.

Distr. Peninsular Thailand and in Malesia: Malaya, Sumatra.

Ecol. Lowland dipterocarp forests, on hills, valleys and stream banks, to 500 m.

Vern. *Resak mempening*, r. *laru*.

Note. A variable species closely related to *V.*

*umbonata*, with which it appears to be undergoing local hybridisation.

**3. *Vatica venulosa* BL.** Mus. Bot. Lugd.-Bat. 2 (1852) 32; WALP. Ann. 4 (1857) 337; MIQ. Fl. Ind. Bat. 1, 2 (1859) 502; DC. Prod. 16, 2 (1868) 623; BURCK, Ann. Jard. Bot. Btzg 6 (1878) 232; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 78; ASHTON, Man. Dipt. Brun. (1964) 79, f. 10; *ibid.* Suppl. (1968) 36; Gard. Bull. Sing. 31 (1978) 17.

**a. ssp. *venulosa*.** — *V. bancana* SCHEFF. Nat. Tijds. N. I. 31 (1870) 348; *ibid.* 32 (1873) 407; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 229, t. 27; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 128; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 269; K. & V. Bijdr. 5 (1900) 127; MOLL & JANSSONIUS, Mikrogr. Holz (1906) 360; KOORD. Exk. Fl. Java 2 (1912) 622; KOORD.-SCHUM. Syst. Verz. (1913) Dipteroc. 4; HALL, f. Med. Rijks-herb. 36 (1918) 4; MERR. En. Born. (1921) 408; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 264; HEYNE, Nutt. Pl. ed. 2 (1927) 1128; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 96; Foxw. Mal. For. Rec. 10 (1932) 263; SYM. Mal. For. Rec. 16 (1943) 217, f. 107; BROWNE, For. Trees Sarawak & Brunei (1955) 99; BACKER & BAKH. f. Fl. Java 1 (1963) 332; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 305, f. 53. — *V. schouteniana* SCHEFF. Nat. Tijds. N. I. 32 (1873) 408. — *Dryobalanops schefferi* HANCE, J. Bot. 14 (1876) 307. — *Retinodendron bancanum* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 129. — *Retinodendron kunstleri* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 129; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 157, t. 189B. — *V. kunstleri* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 127, t. 3, f. 10; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 270; RIDL. Fl. Mal. Pen. 1 (1922) 243. — *V. schefferi* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 128. — *V. lutea* RIDL. Kew Bull. (1926) 60.

Twig, raceme, leaf bud, stipule, midrib above and petiole  $\pm$  persistently densely shortly pale pink-brown puberulent; leaf beneath caducously so. Twigs to 1.5 mm  $\varnothing$  apically, thinly coriaceous, terete, becoming smooth, glabrous. Bud to 2.5 mm long, ovoid, acute. Stipules to 5 mm long, hastate, fugaceous. Leaves 4–12 by 1.5–5 cm, elliptic to ovate-lanceolate, thinly coriaceous; base cuneate, apex shortly acuminate; nerves 7–12 pairs, slender, hardly raised beneath, unraised above, curved at 60°–70°; without distinct secondaries; midrib slender, prominent beneath, slightly depressed above; petioles 5–9 mm long. Panicle to 3 cm long, terminal or 1-axillary, ribbed on drying, singly branched. Flower buds to 1.3 cm long; calyx pink-brown pubescent; flowers otherwise typical. Fruit pedicel to 2 mm long, hidden in the bases of the calyx. Calyx glabrous; lobes subequal, to 3 by 1.3 cm, ovate, acute, revolute, bases cordate. Nut to 1 cm  $\varnothing$ , globose, shortly sparsely pubescent, completely hidden by, but free from, calyx; style remnant to 1.5 cm long, acute.

Distr. Malesia: Malaya (Pahang, Perak), Sumatra (Palembang), Banka, Billiton, W. Java (Bantam), Borneo.



Ecol. Very local, on alluvium river banks and fresh water swamp.

Vern. *Resak letop* (Mal.), *r. banka*, *r. puteh*, *r. seluang*, *aboh*.

**b. ssp. simalurensis** (SLOOT.) ASHTON, Gard. Bull. Sing. 31 (1978) 18. — *V. simalurensis* SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 100; HEYNE, Nutt. Pl. ed. 2 (1927) 1131.

*Leaves* 9–14(–20) by 3.5–5.5(–8) cm, glabrous; nerves 12–15 pairs; *petiole* 8–14 mm long. *Panicle* to 7 cm long.

Distr. *Malesia*: W. Sumatra (P. Simalur, Mentawai Is.).

Ecol. As the species.

**4. *Vatica havilandii*** BRANDIS, J. Linn. Soc. Bot. 31 (1895) 133; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 95; SYM. J. Mal. Br. R. As. Soc. 19 (1941) 155; Mal. For. Rec. 16 (1943) 220, f. 107; BROWNE, For. Trees Sarawak & Brunei (1955) 100; ASHTON, Man. Dipt. Brun. (1964) 71, f. 10; *ibid.* Suppl. (1968) 33.

Young twig, raceme, leaf bud, stipule, and petiole densely persistently deep fulvous-brown flocculent tomentose; sparsely so, caducous, on leaf nervation beneath. *Twig* to 2.5 mm  $\varnothing$  apically, terete or slightly compressed, smooth or slightly flaked. *Bud* to 4 by 3 mm, conical, subacute. *Stipule* to 12 by 2.5 mm, linear, caducous. *Leaves* 8–17 by 2.5–5 cm, narrowly oblong to obovate; base cuneate; acumen to 1 cm long, narrow; nerves 15–20 pairs, slender, prominent beneath, curved towards the apices, at 60°–70°, with prominent short secondaries; midrib terete, prominently raised beneath, slender, flat to slightly raised above; *petiole* 1–1.2 cm long. *Panicle* to 8 cm long, terminal or axillary, terete, singly branched. *Flower bud* to 5 mm long, subglobose. *Calyx* densely rust-brown powdery tomentose; *appendage to connective* as long as anther, stout; flowers otherwise typical. *Fruit pedicel* 5 mm long, 2 mm  $\varnothing$ , pale rufous pubescent, hidden in the base of the calyx. *Calyx lobes* 2.5 by 1.5 cm, ovate, acute, revolute, bases subcordate. *Nut* 12 mm  $\varnothing$  globose, densely rufous pubescent, completely hidden in, but free from, the calyx.

Distr. *Malesia*: Malaya (Perak, Pahang, Trengganu), Borneo (Kapas valley, W. and Central Sarawak, Brunei, Sandakan area).

Ecol. Rare, in Mixed Dipterocarp forests on hills not far from the coast.

Vern. *Resak degong*.

Note. This and the following species share with *V. venulosa* a very distinctive calyx and thus form a well defined group within the genus.

**5. *Vatica chartacea*** ASHTON, Gard. Bull. Sing. 31 (1978) 18.

Medium-sized tree. Young twigs, stipules and panicles caducous buff puberulent; pedicel, ovary and parts of petals exposed in bud persistently so; parts otherwise glabrous. *Twig* c. 2 mm  $\varnothing$  apically, much

branched, pale. *Buds* to 3 by 2 mm  $\varnothing$ , ovoid, acute; *stipule* to 7 by 2 mm, lanceolate, caducous. *Leaves* 11–25 by 3–10 cm, oblong to obovate, thinly chartaceous and wrinkling on drying; base broadly cuneate or obtuse; acumen to 1 cm long, prominent; nerves 16–20 pairs, slender but prominent beneath, distinctly elevated above, arched, with short slender secondaries; tertiary nerves sinuately subscalariform, slender and elevated on both surfaces; midrib stout, terete and prominent beneath, distinctly elevated above; *petiole* 10–22 mm long, slender. *Panicle* to 5 cm long, to 3-axillary, stout. *Flower buds* to 6 by 2 mm, fusiform; *sepals* subequal, lanceolate, subacuminate; *anthers* small, broadly oblong, tapering to the equally long prominent stout appendages; *style* columnar, somewhat longer than ovary, slightly tapering, rimmed beneath the conical stigma; flowers otherwise typical. *Fruit pedicel* to 6 mm long, very slender. *Fruit sepals* to 6 by 1.5 cm, subequal, lanceolate, subacute, cordate at base, 5–7-nerved, ascending and hiding the to 13 by 11 mm ellipsoid nut.

Distr. *Malesia*: W. Borneo (Ulu Kapuas), N.E. Borneo (Bintulu, Sarawak; Beluran and Sandakan to Tawau).

Ecol. Moist low hillsides and banks of sluggish rivers, very local.

Vern. *Resak bunga*, *r. banka*.

**6. *Vatica pauciflora*** (KORTH.) BL. Mus. Bot. Lugd.-Bat. 2 (1852) 31, f. 7; DC. Prod. 16, 2 (1868) 618; MIQ. Sum. (1861) 191; BURCK, Ann. Jard. Bot. Btzig (1887) 226; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 124; ASHTON, Gard. Bull. Sing. 31 (1978) 19. — *Retinodendron pauciflorum* KORTH. Kruidk. (1841) 58. — *Vateria pauciflora* WALP. Rep. 5 (1845) 126; DC. Prod. 16, 2 (1868) 626. — *Elaeogene sumatrana* MIQ. Sum. (1861) 460, 183; M. A. in DC. Prod. 15, 1 (1866) 1257; HALL, f. Med. Rijksherb. 36 (1918) 14. — *V. zollingeriana* DC. Prod. 16, 2 (1868) 618; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 227, t. 29–1; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 124; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 126. — *V. wallichii* DYER, J. Bot. 12 (1874) 154; BURK. & FOXW. J. Str. Br. R. As. Soc. 86 (1922) 273; CRAIB, Fl. Siam. Enum. 1 (1925) 141; HEYNE, Nutt. Pl. ed. 2 (1927) 1132; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 123, f. 12; FOXW. Mal. For. Rec. 10 (1932) 269; BURK. Dict. (1935) 2225; SYM. Mal. For. Rec. 16 (1943) 230, f. 106, 107, 110. — *V. lamponga* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 227, t. 29, f. 3a–d; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 123; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 269; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 313; *ibid.* ed. 2 (1927) 1131; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 264. — *V. forbesiana* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 228; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 124; HEYNE, Nutt. Pl. ed. 2 (1927) 1131. — *V. ruminata* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 227, t. 29, f. 4; HEYNE, Nutt. Pl. ed. 2 (1927) 1132. — *Pachynocarpus wallichii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 135, p.p.; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 136; RIDL. Fl. Mal. Pen. 1 (1922) 250, p.p.; BURK. J. Str. Br. R. As.

Soc. 81 (1920) 75. — *Pachynocarpus ruminatus* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 136. — *V. ovalifolia* RIDL. J. Str. Br. R. As. Soc. 54 (1909) 26. — *V. kelsalli* RIDL. J. Str. Br. R. As. Soc. 54 (1909) 27; Fl. Mal. Pen. 1 (1922) 244. — *Pachynocarpus umbonatus* (non HOOK. f.) RIDL. Fl. Mal. Pen. 1 (1922) 249, p.p. — *Pachynocarpus ridleyanus* (non ANDERS.) RIDL. Fl. Mal. Pen. 1 (1922) 250, p.p. — *V. sumatrana* SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 120, f. 11; HEYNE, Nutt. Pl. ed. 2 (1927) 1131; BACKER & BAKH. f. Fl. Java 1 (1963) 332.

Small or medium-sized tree. Outside of perianth  $\pm$  persistently pale grey-brown cinereous; ovary, panicles, and twig apices caducously so; elsewhere glabrescent. *Twig* c. 3 mm  $\varnothing$  apically, much branched, pale grey-brown, usually minutely rugulose. *Buds* small, ovoid; *stipules* to 8 mm long, linear, becoming reflexed. *Leaves* 6.5–20 by 2.2–8 cm, variable in size, elliptic-lanceolate, thinly coriaceous; base cuneate; acumen to 1.5 cm long, prominent; nerves 6–9 pairs, arched, ascending, slender and hardly more elevated beneath than above; *petiole* 10–18 mm long, smooth, drying black. *Panicle* to 9 cm long, terminal or subterminal axillary, many-flowered, irregularly branching. *Flower bud* to 10 by 3 mm, fusiform; *appendages* minute, hardly exceeding anthers; *style* columnar, longer than ovary, expanding somewhat distally below the small conical style; flowers otherwise typical. *Fruit pedicel* to 7 by 3 mm, prominent; *calyx lobes* to 5 mm  $\varnothing$ , hemispherical, incrassate,  $\pm$  adnate round the impressed base of the nut; *nut* to 3 by 3 cm, ovoid, subacute, with 3 distinct loculicidal furrows; pericarp thick, corky, verrucose.

Distr. Peninsular Thailand, and in *Malesia*: Malaya, Sumatra (Palembang, Lampong), Banka.

Ecol. Banks of sluggish rivers, fresh water swamps; common.

Vern. *Rêsak laru*, *r. paya*, *r. ayer*, *r. pasir*, *damar mata kuching* (Malaya), *r. padang*, *r. rawang* (Sumatra).

Notes. Occupying the same habitat as *V. umbonata* and indistinguishable from it when sterile; it is by the fruit calyx nevertheless consistently distinguishable. Though *V. pauciflora* is confirmed only as far north as Songkhla, *V. thorelii* PIERRE of Cochinchina, based on THOREL & HARMAND's herb. Pierre 1586, is known only in flower and is indistinguishable in that condition from it; moreover I have seen undoubted fruit of *V. pauciflora* washed up on the beach at Kompong Som, S.E. Cambodia.

See also 56. *V. obtusa* BURCK.

A specimen from Sikundur For. Res., W.N.W. of Medan (N.E. Sumatra) (DE WILDE & DE WILDE-DUYFJES 19537) bears fruit which differs in having greatly enlarged adnate sepals, in this resembling *V. umbonata*, so far unknown from Sumatra. This may represent a hybrid between the two species, nevertheless.

7. *Vatica ridleyana* BRANDIS in Hook. f. Ic. Pl. 25 (1895) t. 2401; J. Linn. Soc. Bot. 31 (1895) 122, t. 3, f.

5; BURK. & FOXW. J. Str. Br. R. As. Soc. 86 (1922) 277; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 49, 73, f. 1d; FOXW. Mal. For. Rec. 10 (1932) 268; BURK. Dict. (1935) 224; SYM. Mal. For. Rec. 6 (1943) 227, f. 107. — *Pachynocarpus ridleyanus* ANDERSON, Index Bot. Gard. Sing. (1912) 9; BURK. & FOXW. J. Str. Br. R. As. Soc. 86 (1922) 272; RIDL. Fl. Mal. Pen. 1 (1922) 250, p.p.

Medium-sized tree. Twigs, petioles, panicles, ovaries and parts of perianth exposed in bud  $\pm$  persistently ochereous cinereous, parts elsewhere glabrescent. *Twig* c. 2–3 mm  $\varnothing$  apically, much branched, brown rugulose. *Buds* to 3 by 2 mm, ovoid. *Leaves* 6–14 by 3–7 cm, elliptic to narrowly ovate or obovate, coriaceous, dull beneath; base cuneate; apex subacute or shortly broadly acuminate; margin narrowly subrevolute; nerves 5–7 pairs, ascending, slender but prominent beneath, evident above as also the midrib and reticulate tertiary nerves; *petiole* 8–15 mm long, 2–3 mm  $\varnothing$ , stout. *Panicle* to 15 cm long but usually shorter, terminal or axillary, irregularly branched. *Flower bud* 7 by 2 cm, fusiform; *appendage* short, deltoid; *style* somewhat longer than ovary, columnar, expanding into the prominent conical stigma; flowers otherwise typical. *Fruit pedicel* short, stout; *calyx lobes* to 3 by 3 mm, short, deltoid, incrassate, relaxed, adnate to the base of the 4.5 by 1.8 cm fusiform beaked coarsely verrucose nut.

Distr. *Malesia*: Sumatra (Palembang), Singapore.

Ecol. Mixed Dipterocarp forest at low altitudes; rare.

Vern. *Rêsak buah cana*.

8. *Vatica soepadmoi* ASHTON, Gard. Bull. Sing. 31 (1978) 19.

Small tree. Twigs, leaf buds, petioles, midrib above, and panicles densely persistently pale brown scabrid puberulent, nuts evenly so; nervation beneath sparsely so. *Twigs* c. 2 mm  $\varnothing$ , ribbed at first, becoming terete. *Leaf buds* to 8 by 4 mm, lanceolate, acute. *Leaves* 7.5–12 by 3–5.5 cm, elliptic, oblong to narrowly ovate, coriaceous, somewhat bullate between the nerves; margin subrevolute; base obtuse; acumen to 1.5 cm long, slender, prominent; nerves c. 11 pairs, arched, tending to branch within the margin and form a  $\pm$  indistinct looped intramarginal nerve, prominent beneath, shallowly depressed above, with short slender secondary nerves; tertiary nerves subreticulate, evident beneath,  $\pm$  obscure above; midrib stoutly prominent beneath, evident but  $\pm$  channelled above; *petiole* 10–15 mm long, slender. *Panicle* to 6.5 cm long, axillary, hardly branched. *Flowers* unknown. *Fruit pedicel* to 6 mm long, prominent; *calyx lobes* equal, to 18 by 10 mm, lanceolate, acute, recurved inwards and  $\pm$  revolute thus resembling claws; *nut* ovoid, not known at maturity.

Distr. *Malesia*: E. Sumatra (Upper Riouw: Pekanbaru, Singkep).

Ecol. Low hills.

9. *Vatica bella* SLOOT. Bull. Jard. Bot. Btzig III, 9



(1927) 102, f. 6; Foxw. Mal. For. Rec. 10 (1932) 265; BURK. Dict. (1935) 2223; SYM. Mal. For. Rec. 16 (1943) 218, f. 107.

Medium-sized tree to 50 m tall. Twigs, leaf buds, petioles, midrib above and panicle densely persistently rufous cinereous, calyx and ovary caducously so, leaf undersurface sparsely caducously so. *Twig* c. 2 mm  $\varnothing$  apically, slender, terete, much branched, pale brown. *Bud* to 3 by 2 mm, small, ovoid; *stipules* fugaceous, not seen. *Leaves* 5–14 by 2.6 cm, elliptic-ovate, coriaceous; base cuneate; acumen to 1 cm long or short; margin frequently subrevolute; nerves 11–12 pairs, arched, ascending, slender but distinctly elevated beneath, evident above as also the midrib; tertiary nerves densely subreticulate, hardly elevated on either surface; *petiole* 5–15 mm long, short, relatively slender. *Panicle* to 2 cm long, axillary, congested, irregularly branched. *Flower buds* to 8 by 3 mm, lanceolate; appendage to connective as long as anther cells, deltoid, prominent; style slender, twice as long as ovary; stigma shortly conical; flowers otherwise typical. *Fruit pedicel* to 3 by 2 mm; *calyx lobes* to 30 by 13 mm, lanceolate, acute, c. 6 mm wide at the revolute base, becoming reflexed; *nut* to 2.5 by 2.5 cm, turbinate, verrucose, with to 1 cm long persistent tapering style remnant.

Distr. *Malesia*: Malaya (south from Perak and Pahang).

Ecol. Locally common in Mixed Dipterocarp forest, undulating land beneath 250 m.

Vern. *Rèsak kěluang*, *r. laru*, *damar kěluang*.

**10. *Vatica rassak*** (KORTH.) BL. Mus. Bot. Lugd.-Bat. 2 (1852) 31, incl. var. *subcordata* BL.; WALP. Ann. 4 (1857) 337; Miq. Fl. Ind. Bat. 1, 2 (1859) 502; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 619; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 225; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 125; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 270; GRESH. Ind. Mercuur 23 (1900) n. 37, tab.; Schets. Nutt. Ind. Pl. (1900) t. 50; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 313; *ibid.* ed. 2 (1927) 1130; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 73, 104, f. 1c; *ibid.* III, 17 (1942) 223, f. 22–24; ASHTON, Gard. Bull. Sing. 31 (1978) 20. — *Retinodendron rassak* KORTH. Kruidk. (1841) 56, t. 8. — *Vateria rassak* WALP. Rep. 5 (1845) 126. — *V. papuana* DYER, J. Bot. 16 (1878) 100; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 229; K.SCH. & HOLLER. Fl. Kais.-Wilh. Land (1889) 52; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 127; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 270; DIELS, Bot. Jahrb. 57 (1927) 463; LANE-POOLE, For. Res. Papua (1925) 120; SLOOT. Nova Guinea 14 (1926) 226; Bull. Jard. Bot. Btzig III, 9 (1927) 73, 112, f. 1b; MERR. Philip. J. Sc. 30 (1926) 411; WHITE & FRANCIS, Proc. R. Soc. Qsl. 38 (1927) 247; HEYNE, Nutt. Pl. (1927) 1129; Foxw. Philip. J. Sc. 67 (1938) 328; SLOOT. Bull. Jard. Bot. Btzig III, 17 (1942) 233, f. 27; *apud* Holth. & Lam, Blumea 5 (1942) 214; Reinwardtia 2 (1952) 63, f. 21; MEIJER & WOOD. Sabah For. Rec. 5 (1964) 314, f. 56; ASHTON, Man. Dipt. Brun. Suppl. (1968) 35, f.

5. — *Vateria papuana* DYER ex HEMSL. Bot. Chall. 1, 4 (1884–85) 123, 287, 296, t. 64B; K.SCH. & HOLLER. Fl. Kais. Wilh. Land (1889) 52; HEYNE, Nutt. Pl. ed. 2 (1927) 1129. — *V. moluccana* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 226, t. 26; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 124; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 313; *ibid.* ed. 2 (1927) 1129. — *Retinodendron moluccanum* HEIM, Rech. Dipt. (1892) 104. — *V. schumanniana* GILG, Bot. Jahrb. 18 (1894) Beibl. 45: 38; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 127; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 269, fig.; K.SCH. & LAUT. Fl. Schutzgeb. (1901) 451; DIELS, Bot. Jahrb. 57 (1922) 463; (in Index Kewensis erron. under *Shorea*). — *V. celebensis* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 126, t. 3, f. 6; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 77; *ibid.* III, 17 (1942) 254; Reinwardtia 2 (1952) 65. — *V. subcordata* (BL.) HALL. f. Med. Rijksherb. 36 (1918) 4; SLOOT. Bull. Bot. Gard. Btzig III, 17 (1942) 228, f. 25–26. — *V. celebica* SLOOT. Bull. Bot. Gard. Btzig III, 17 (1942) 237, f. 28–29. — **Fig. 44.**

*Twig*, petioles, buds, and stipules outside (glabrous within) very shortly evenly persistently pale buff pubescent, leaf nervation beneath sparsely so. *Twig* c. 3 mm  $\varnothing$ , stout, crooked, ribbed, becoming rugose, flaky, pale grey-brown; stipule scars prominent, horizontal; internodes 1–3 cm long. *Bud* to 4 by 4 mm, ovoid-conical, subacute. *Stipules* to 14 by 4 mm, lorate, subacute, subsistent. *Leaves* 13–32 by 5–11 cm, oblong to narrowly elliptic, thickly coriaceous; base broadly cuneate to subcordate; acumen to 1.5 cm long; nerves (10–)16–20 pairs, prominent beneath, slightly elevated above, arched at 50°–60°, with short hardly elevated secondary nerves; tertiary nerves reticulate; midrib prominent beneath, applanate above; *petiole* 2–2.5 cm long, stout, not geniculate, drying pale buff pubescent. *Panicle* to 14 cm long, terminal or axillary, ribbed, at first shortly evenly buff pubescent, becoming pale brown flaky; irregularly branched, with many branches near base, appearing fascicled. *Flower bud* to 14 by 3 mm, fusiform; *calyx* densely shortly pale buff pubescent; flowers otherwise typical. *Fruit* glabrous. *Pedicel* to 3 mm long, stout. *Calyx lobes* to 12 by 7 mm, deltoid, acute, incrassate, reflexed, recurved. *Nut* to 3 by 3.5 cm, oblong, symmetrical and obtuse to ovoid, more or less prominently attenuate-acute and asymmetrically twisted, sometimes irregularly pitted, furrowed at the sutures, minutely verruculose and rugulose; pericarp thick, corky.

Distr. *Malesia*: Borneo (E. of Rejang valley and Sampit, commonest on E. coast), S. Philippines (Sulu Is.: Tawi Tawi), Celebes, Moluccas (Sula Is.: Mangoli; Morotai, Halmahera, Batjan, Obi Is., Aru Is.), New Guinea, Sudest I.

Ecol. River-banks in Borneo, elsewhere also on hills to 400 m, locally abundant.

Vern. *Rèsak irian*, *r. damau*, *r. ayêr*, *r. tēbong* (Sabah), *damar dērêh*, *d. putêh*, *numuh*, *singkodoh putêh* (Celebes), *kokolaka*, *bou-ura*, *por*, *damar hirur*, *manauri*, *laintoti*, *wakaju*, *imoimo*, *asuk*, *baia*, *guimbur*, *lagima*, *mutani*, *owi*, *simbiau* (New Guinea),



Fig. 44. Fruiting twig of *Vatica rassak* (KORTH.) BL. near Sarmi, c. 200 km west of Hollandia, Irian Jaya (Photogr. KARSTEL, Dec. 1957).

*doyong* (Sula Is.), *damar hiru*, *salo hiru*, *damar atung*, *geru* (Moluccas).

Notes. Another variable semi-gregarious chiefly riparian species (see e.g. *V. umbonata*).

The above description defines my interpretation of this variable species. The large, oblong-elliptic, coriaceous leaves with long petiole, and the large, corky nut, are characteristic though the nut shape is very variable (in part owing to the degree of maturity on herbarium specimens). Its distribution into seasonal areas and its semi-gregarious ecology parallel that of other polymorphic species such as *Anisoptera costata* KORTH., *A. thurifera* (BLCO) BL., and *Vatica umbonata* (HOOK. f.) BURCK. The variation is locally too great to clearly distinguish geographical subspecies.

Some hybridisation appears to occur with *V. umbonata* in East Sabah.

**11. *Vatica granulata*** SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 112, f. 10; *ibid.* III, 17 (1941) 136, f. 20; ASHTON, Man. Dipt. Brun. (1964) 70, f. 10; *ibid.* Suppl. (1968) 32; Gard. Bull. Sing. 31 (1978) 21.

**a. ssp. *granulata*.**

Young twig, leaf bud, stipule, petiole and nervation beneath densely shortly yellow scabrid tomentose at first, glabrescent or sparsely pubescent on nervation. Twig to 3 mm  $\varnothing$  apically, stout, angular, persistently papery flaky. Bud to 4 by 3 mm, conical, subacute. Stipule to 6 by 4 mm, hastate, subacute, caducous. Leaves 10–20 by 2.7–7 cm, coriaceous, narrowly obovate; base narrowly obtuse; acumen to 6 mm long; nerves 12–14 pairs, prominent beneath, well spaced,

slightly sunken above. Petiole 1.2–2 cm long, stout. Flowers unknown. Inflorescence unknown. Fruit pedicel to 1 mm long, fruit subsessile. Calyx lobes to 7 by 4 mm, chartaceous, deltoid, brittle, reflexed, glabrous. Nut to 3.5 by 4 mm, ovoid, obtuse or subacute, coarsely granulate, dehiscent along 3 distinctly furrowed sutures at germination.

Distr. *Malesia*: Borneo.

Ecol. Widespread, locally abundant, on high ridges at 500–1200 m.

Vern. *Rəsək ranting bersisek*.

**b. ssp. *sabaensis*** ASHTON, Gard. Bull. Sing. 31 (1978) 21.

Differing as follows: Leaf by 6–10 cm, petiole 12–20 mm long. Stipules to 3 by 2 cm, oblong to lanceolate, acute, obtuse to subcordate, subsistent. Fruit sepals to 20 by 12 mm, elliptic, revolute, reflexed.

Distr. *Malesia*: Borneo (Crocker range, S.W. Sabah to Kelabit Highlands, N.E. Sarawak).

Ecol. As type subspecies, to 1700 m.

Vern. *Rəsək pengasoh*.

**12. *Vatica sarawakensis*** HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 970; Rech. Dipt. (1892) 109; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 124; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 106, f. 7; BROWNE, For. Trees Sarawak & Brunei (1955) 101; ASHTON, Gard. Bull. Sing. 20 (1963) 252; Man. Dipt. Brun. (1964) 77, f. 10; *ibid.* Suppl. (1968) 36; Gard. Bull. Sing. 22 (1967) 262; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 319, f. 57. — *Retinodendropsis aspera* HEIM, C. R. Assoc. Fr. Pau 1892 (1893) 470; cf. ASHTON, Gard. Bull. Sing. 22 (1967) 262. — *V. ramiflora* SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 118, p.p.; in Merr. Pl. Elm. Born. (1929) 205; Bull. Bot. Gard. Btzig III, 17 (1942) 240, f. 30; Reinwardtia 5 (1961) 479; BROWNE, For. Trees Sarawak & Brunei (1955) 101.

Twig, raceme, leaf bud, stipule and petiole densely pale brown to fulvous scabrid tomentose, sparsely so on leaf nervation beneath. Twig to 5 mm  $\varnothing$  apically, stout, becoming ribbed, smooth or finely cracked. Bud to 8 by 5 mm, conical, subacute. Stipule to 15 by 5 mm, narrowly hastate, acute. Leaves 22–35 by 7–15 cm, thinly coriaceous, oblong to obovate; base obtuse; acumen to 1.4 cm long, deltoid; nerves 15–28 pairs, prominent beneath, flat or slightly raised above; petiole 1–2 cm long, to 4 mm  $\varnothing$ , stout. Panicle to 12 cm long, axillary to ramiflorous (rarely terminal), to 3-axillary, terete or angled; much branched, the branchlets cymose; bracts to 8 by 4 mm, narrowly deltoid, subacute, densely rufous tomentose, subsistent. Flower bud to 8 mm long; calyx shortly red-brown pubescent; appendage to connective over  $\frac{1}{2}$  length of anther, prominent; flower otherwise typical. Fruit glabrous; pedicel to 2 mm long. Calyx lobes subequal, to 16 by 7 mm, oblong-hastate, obtuse, becoming reflexed, somewhat revolute. Nut to 2.5 by 2.5 cm, subglobose to ovoid, verrucose-lenticellate, with 3 distinct sutures uniting at the apex; style remnant short but prominent.



Distr. *Malesia*: Borneo (Sarawak to Sabah; S.E. Borneo to P. Laut and Balikpapan).

Ecol. Scattered in Mixed Dipterocarp forest on clay rich soils on undulating land and hills below 1000 m.

Vern. *Rēsak daun bēsar*, *r. sarawak*, *damar tingkis*.

Note. The fruit sepals of *E. Borneo* specimens (*V. ramiflora* SLOOT.) are foliose and rather broad, these on Sarawak specimens narrow and incrassate. Further collections may justify distinction of two subspecies in *V. oblongifolia*.

**13. *Vatica albiramis* SLOOT.** Bull. Jard. Bot. Btzig III, 9 (1927) 101, f. 5; in Merr. Pl. Elm. Born. (1929) 205; ASHTON, Man. Dipt. Brun. (1964) 66, f. 10; *ibid.* Suppl. (1968) 30; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 305, f. 52.

Parts glabrous but for the shortly sparsely caducous pubescent calyx and shortly fulvous caducous pubescent ovary. Twig to 1 mm  $\varnothing$  apically, slender, smooth to rugulose. Bud to 2 by 1 mm, conical, acute. Stipule to 16 by 3.5 mm, hastate, subacute, caducous. Leaves 8–20 by 3–7 cm, thinly coriaceous, elliptic to lanceolate; base  $\pm$  narrowly cuneate; acuminate to 1.5 cm long, narrow; nerves 4–6 pairs, rather broad, slightly raised on both surfaces, more prominently so beneath, curved, continuing almost parallel to the margin before terminating, at 45°–50° (–70°); midrib broad, rounded, slightly raised on both surfaces; tertiary nerves subscalariform; petiole 1–1.3 cm long. Panicle to 28 cm long, terminal or axillary, lax, spreading, glabrous, terete; doubly or trebly branched. Flower bud to 1.5 cm long, slender; calyx shortly sparsely pubescent; corolla rich lemon-yellow; appendage to connective rudimentary; flowers otherwise typical. Calyx lobes subequal, to 12 by 4 mm, ovate, obtuse, tapering to 3.5 mm broad at base, coriaceous, glabrous, becoming reflexed. Nut to 1.2 by 1.2 cm, globose, without style remnant, shortly fulvous pubescent.

Distr. *Malesia*: Borneo (Rejang valley to Kinabalu; E. Sabah).

Ecol. Clay rich soils, low hills and ridges; to 1400 m in Kinabalu area.

Vern. *Rēsak ranting puteh*, *r. puteh*.

Note. Differing from the closely related *V. hullettii* of Malaya in the narrow fugaceous hastate stipules and totally glabrous young parts and petiole.

**14. *Vatica oblongifolia* HOOK. f.** Trans. Linn. Soc. 23 (1862) 160; MQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 619; WALP. Ann. 7 (1868) 378; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 229; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 126, t. 3, f. 11; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 109, f. 8; *ibid.* III, 17 (1941) 135; BROWNE, For. Trees Sarawak & Brunei (1955) 101; ASHTON, Man. Dipt. Brun. (1964) 75, f. 10, *p.p.*; *ibid.* Suppl. (1968) 34; Gard. Bull. Sing. 22 (1967) 264, pl. 3–7; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 314, f. 55, pl. 30b (stem). — Fig. 45.



Fig. 45. Stem-base of young tree of *Vatica oblongifolia* HOOK. f. *ssp. oblongifolia*, with flowering and fruiting twigs. Sibulu R., Mengalang For. Res., Beaufort Distr. (Photogr. G. H. S. Wood, July 1954, KEP 80255).

Note. The taxa I here recognise as subspecies are rather constant and rarely difficult to identify. Though the full range of variation they together manifest is great, the distinctive characters of the depressed twig and short dense vinose indumentum unites them as a single entity.

#### KEY TO THE SUBSPECIES

1. Petiole at most 14 mm long; leaf elliptic  
**b. *ssp. elliptifolia***
1. Petiole at least 15 mm long.
2. Fruit calyx lobes more than 10 by 6 mm; nerves at least 26 pairs.
3. Leaf broadly oblong, base  $\pm$  cordate  
**c. *ssp. crassilobata***
3. Leaf narrowly obovate, base  $\pm$  cuneate  
**d. *ssp. multinervosa***

2. Fruit calyx lobes at most 4 by 3 mm; nerves at most 18 pairs.
4. Leaf narrowly elliptic, base cuneate, petiole 1.5–2.5 cm long . . . **e. ssp. selakoensis**
4. Leaf obovate to oblong, base obtuse, petiole 2.5–5 cm long . . . **a. ssp. oblongifolia**

**a. ssp. oblongifolia.** — ASHTON, Gard. Bull. Sing. 22 (1967) 264, pl. 3. — *V. furfuracea* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 228; BECC. For. Born. (1902) 570. — **Fig. 45.**

Young twig, raceme, calyx, leaf bud, stipule, petiole and leaf nervation densely shortly evenly persistently vinous cinereous. *Twig c.* 4 by 2 mm  $\varnothing$  apically, compressed; becoming terete, smooth to finely cracked and flaked. *Leaf bud* to 3 by 5 mm, conical, subacute, compressed. *Stipule* to 4.5 by 1.2 cm, oblong, obtuse. *Leaves* 10–31 by 4.5–10 cm, coriaceous, oblong to obovate; base obtuse; apex  $\pm$  abruptly tapering, with or without an up to 1 cm long acumen; nerves 10–18 pairs, prominent beneath, curved distally, at 50°–80°; with short  $\pm$  prominent secondary nerves; midrib prominent, terete beneath, depressed above; *petiole* 2.5–5 cm long, geniculate. *Panicle* to 8 cm long, compressed, singly or doubly branched, terminal or to 3-axillary. *Flower bud* to 1.5 cm long, slender; petals cream, purplish towards base at first; flowers typical. *Fruit pedicel* to 8 mm long. *Calyx lobes* to 3 by 2 cm, equal, thickly coriaceous, deltoid, acute,  $\pm$  reflexed. *Nut* to 2 cm long and  $\varnothing$ , globose, faintly 3-sulcate.

Distr. *Malesia*: Borneo (widespread).

Ecol. Leached shallow soils on low hills and on ridges to 700 m inland.

Vern. *Resak mambangan, r. daun panjang.*

**b. ssp. elliptifolia** ASHTON, Gard. Bull. Sing. 22 (1967) 265, pl. 7; Man. Dipt. Brun. Suppl. (1968) 34.

*Twigs c.* 3 by 2 mm  $\varnothing$ . *Leaves* 12–20 by 3.5–7 cm, elliptic or obovate; base broadly cuneate; acumen to 1 cm long, short, slender; nerves 14–16 pairs, slender, prominent beneath; *petiole* 10–14 mm long, short. *Fruit calyx lobes* to 8 by 4 mm, oblong, obtuse, revolute.

Distr. *Malesia*: Borneo (Central Sarawak, Brunei).

Ecol. Rare, deep sandy soils on subcoastal hills.

**c. ssp. crassilobata** ASHTON, Gard. Bull. Sing. 22 (1967) 265, pl. 5; Man. Dipt. Brun. Suppl. (1968) 34.

*Twigs c.* 4 by 2 mm  $\varnothing$ , stout. *Leaves* 11.5–21 by 4.5–10.5 cm, broadly oblong; base obtuse or cordate; acumen short, broad; nerves 16–23 pairs, prominent beneath; *petiole* 1.8–2.8 cm long. *Fruit calyx lobes* to 15 by 12 mm, obovate, obtuse to emarginate, subrotate.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Ecol. Local, Mixed Dipterocarp forests on deep leached sandy soils near Pleistocene coastlines.

**d. ssp. multinervosa** ASHTON, Gard. Bull. Sing. 22 (1967) 265, pl. 6; Man. Dipt. Brun. Suppl. (1968) 34.

*Twig c.* 4 by 2 mm, stout. *Leaves* 14–31 by 4–8.5 cm, narrowly obovate; base narrowly obtuse or cuneate; acumen to 1.5 cm, long, slender; nerves 18–27 pairs, very prominently elevated beneath, with prominent short secondaries and tertiaries; *petiole* 1.5–2.5 cm long. *Fruit calyx lobes* to 13 by 8 mm, oblong, obtuse, reflexed.

Distr. *Malesia*: Borneo (Sarawak, Sabah to Nunukan I.).

Ecol. Frequent on deep fertile clay-rich soils; especially on volcanic and basement rocks.

**e. ssp. selakoensis** ASHTON, Gard. Bull. Sing. 22 (1967) 264, pl. 4; Man. Dipt. Brun. Suppl. (1968) 34.

*Twig c.* 2 by 1 mm, slender. *Leaves* 6.5–22 by 2.5–6.5 cm, narrowly elliptic, base cuneate, acumen to 1.5 cm long, slender; nerves 11–18 pairs, slender, hardly raised beneath; *petiole* 1.5–2.5 cm long. *Fruit calyx lobes* to 4 by 3 mm, oblong, obtuse.

Distr. Borneo (W. Sarawak).

Ecol. Abundant in summit forests of granodiorite mountains, 600–1400 m.

**15. *Vatica dulitensis*** SYM. Gard. Bull. S.S. 8 (1934) 35, pl. 10; BROWNE, For. Trees Sarawak & Brunei (1955) 100; ASHTON, Man. Dipt. Brun. (1964) 69, f. 10, pl. 22 (bark); *ibid.* Suppl. (1968) 31; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 308.

Young twig, raceme, leaf bud, stipule (both surfaces), petiole, and leaf nervation beneath shortly densely dark vinous tomentose, caducous on nervation, persistent elsewhere. *Twig* to 1 mm  $\varnothing$  apically, slender, much branched, becoming smooth glabrous. *Bud* to 2 by 1.5 mm, broadly ovoid, obtuse. *Stipule* to 3 by 1 mm, narrowly hastate, acute, caducous. *Leaves* 4–11 by 0.8–3.2 cm, thinly coriaceous, narrowly obovate to elliptic-lanceolate, base cuneate; acumen to 1.5 cm long, caudate; nerves 10–12 pairs, slender, hardly raised beneath, curved, at 50°–60°, with short slender secondaries; midrib slender, prominent beneath, applanate above; *petiole* 6–10 mm long, slender. *Panicle* to 2.5 cm long, singly or doubly branched, terminal or axillary. *Flower bud* to 6 mm long, small. *Calyx* densely vinous cinereous; *corolla* cream; *appendage* to *connective* short, acute; flowers otherwise typical. *Fruit pedicel* to 3 mm long, slender. *Calyx lobes* equal, to 14 by 5 mm, oblong, obtuse, base to 5 mm broad, glabrous outside, vinous caducous puberulent within, becoming rotate to reflexed. *Nut* to 8 mm  $\varnothing$ , globose; style remnant to 1 mm long, linear, densely shortly vinous tomentose.

Distr. *Malesia*: Borneo (Sarawak to Sabah, Bulungan).

Ecol. Locally abundant on shale ridges, to 1350 m in Kinabalu area, occasional on undulating clay rich soils in lowlands.

Vern. *Resak tiang.*

**16. *Vatica pedicellata*** BRANDIS, J. Linn. Soc. Bot. 31 (1895) 125, t. 3, f. 12–14; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 111, f. 9;



BROWNE, For. Trees Sarawak & Brunei (1955) 101; ASHTON, Man. Dipt. Brun. Suppl. (1968) 35, f. 5.

Twig, bud, petiole and stipule persistently densely shortly vinous pubescent. *Twig* c. 2 mm  $\varnothing$  apically, slender, subterete to slightly compressed, lax; stipule scars short, horizontal. *Bud* to 4 by 2 mm, ovoid, compressed, acute. *Stipule* to 7 by 2 mm, lorate, subacute, caducous. *Leaves* 9–23 by 3.5–7.5 cm, medium-sized, elliptic to lanceolate, coriaceous, with somewhat revolute margin; base obtuse, rarely cuneate, acuminate to 2 cm long, slender; nerves 9–15 pairs, slender, hardly raised on either surface but more prominent beneath, at 60°–80°, arched, tending to anastomose distally forming an indistinct looped intramarginal nerve; with many short slender secondaries; tertiary nerves reticulate; midrib prominent beneath, slender but elevated above yet set in a distinct trough; *petiole* 1–2.5 cm long, not geniculate, terete, drying rugulose, shortly evenly vinous pubescent. *Panicle* to 8 cm long, axillary, ribbed, compressed, slender, densely shortly evenly persistently vinous pubescent; singly or slightly doubly branched, branchlets bearing to 6  $\pm$  secund flowers; *bracteoles* fugaceous. *Flower bud* to 6 by 2 mm, fusiform; *calyx* vinous puberulent; *petals* cream with a purplish suffusion outside; flowers otherwise typical. *Fruit* entirely shortly evenly vinous pubescent, caducous on calyx, otherwise persistent. *Pedicle* to 8 mm long, slender. *Calyx lobes* to 6 by 4 mm, oblong, obtuse, revolute, reflexed. *Nut* to 18 by 22 mm, becoming subglobose, subacute; sutures obscure.

Distr. *Malesia*: Borneo (Sarawak west of the Lupar).

Écol. Locally frequent in Heath forest, usually on shallow rocky soils near coast.

Note. Clearly close to *V. oblongifolia* but lacking its distinctive compressed twig.

**17. *Vatica rotata*** ASHTON, Gard. Bull. Sing. 22 (1967) 270, pl. 13; Man. Dipt. Brun. Suppl. (1968) 36, f. 5.

Twigs, leaf bud, petiole, and midrib beneath persistently densely vinous sericeous. *Twig* c. 1 mm  $\varnothing$ , slender, much branched, terete, smooth. *Leaf bud* c. 2 by 1 mm, ovoid, subacute. *Stipule* unknown, fugaceous. *Leaves* 5.5–10 by 3–5 cm, broadly elliptic, ovate, coriaceous; base obtuse; acuminate to 8 mm long; nerves 9–11 pairs, arched, at 65°–80°, hardly raised on either surface; tertiary nerves slender, densely reticulate; midrib prominent beneath, evident towards base above, otherwise obscure, depressed; *petiole* 8–12 mm long, slender, drying vinous to black. Flowers unknown. *Fruit* and *inflorescence* entirely persistently evenly vinous sericeous. *Panicle* to 1.5 cm long, terminal or axillary, slender, terete, singly branched. *Fruit pedicel* to 9 mm long, slender. *Calyx lobes* to 7 by 4 mm, equal, suborbicular, revolute, rotate. *Nut* (immature) c. 4 mm  $\varnothing$ , subglobose, obtuse, with 3 indistinct sutures.

Distr. *Malesia*: Borneo (Central Sarawak, Kapuas valley).

Écol. Mixed Dipterocarp—Heath forest ecotone, deep sandy soil.

**18. *Vatica vinosa*** ASHTON, Gard. Bull. Sing. 19 (1962) 318, pl. 32; Man. Dipt. Brun. (1964) 79, f. 10; *ibid.* Suppl. (1968) 37.

Young twig, raceme, leaf bud, stipule, petiole and nervation beneath  $\pm$  persistently shortly evenly rich vinous pubescent, tending to rub off leaf undersurface. *Twig* to 1.5 mm  $\varnothing$  apically, slender, much branched, becoming pale grey and brown mottled, glabrous, frequently thinly cracked and flaked. *Bud* to 1.5 mm long and  $\varnothing$ , ovoid, obtuse. *Stipule* to 5 by 2.5 mm, oblong, subacute, caducous. *Leaves* 6–15 by 1.5–4.5 cm, elliptic to lanceolate; base narrow, obtuse to cuneate; acuminate to 1.2 cm long, narrow; nerves 12–20 pairs, slender,  $\pm$  prominent beneath, curved, close set, at 50°–70° to the midrib, with short slender secondary nerves; midrib slender, prominent, terete below, flat above; *petiole* 6–13 mm long, slender. *Panicle* to 7 cm long, terminal or axillary, terete, singly or doubly branched; *flower bud* to 6 mm long, small; *calyx* sparsely vinous cinereous; *appendage to connective* short, obtuse; flowers otherwise typical. *Fruit calyx* densely shortly vinous puberulent on both surfaces; lobes to 9 by 8 mm, equal, obovate,  $\pm$  abruptly revolute, thickened, reflexed at base but curving outwards and  $\pm$  rotate apically; *nut* to 8 mm  $\varnothing$ , globose, densely vinous puberulent; style remnant short.

Distr. *Malesia*: Borneo (N.E. of Rejang valley to E. Sabah and Tarakan).

Écol. Fertile clay-rich soils in Mixed Dipterocarp forest below 300 m.

Vern. *Resak tangkai unggu*.

**19. *Vatica scortechinii*** (KING) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 122, t. 3 f. 9, p.p.; RIDL, Fl. Mal. Pen. 1 (1922) 244; CRAIB, Fl. Siam. Enum. 1 (1925) 141, p.p.; SLOOT, Bull. Jard. Bot. Btg III, 9 (1927) 73, 108, f. 1e, p.p.; FOXW. Mal. For. Rec. 10 (1932) 267, p.p.; BURK. Dict. (1935) 2224; SYM. J. Mal. Br. R. As. Soc. 19, 2 (1941) 155; Mal. For. Rec. 16 (1943) 227, f. 107; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 319. — *Retinodendron scortechinii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 128; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 157, t. 190.

Medium-sized tree. Young parts ferruginous cinereous, caducous except on twig apices and panicles. *Twig* 3–6 mm  $\varnothing$  apically, straight, terete or ribbed especially along the leaf traces, with conspicuous slightly downpointing stipule scars. *Buds* to 5 by 3 mm, ovoid-lanceolate, acute, hidden within the to 35 by 12 mm lanceolate subsistent stipules. *Leaves* 13–40 by 5–16 cm, oblong-lanceolate or oblanceolate, thinly coriaceous; base obtuse or occasionally cordate; margin  $\pm$  narrowly revolute; apex subacuminate to acute; nerves 14–25 pairs, arched, slender but prominent beneath, distinctly elevated above as also the midrib, with many short indistinct secondary nerves; tertiary nerves reticulate, distinctly elevated on both surfaces; *petiole* 13–25(–40) mm long, 3–5 mm  $\varnothing$ , stout, characteristically puckered on drying. *Panicle* to 9 cm long, axillary to ramiflorous; *flower buds* to

14 by 5 mm, fusiform; *anthers* oblong, tapering, relatively long; appendages very short; *style* somewhat longer than ovary, columnar, capitate; stigma conical, prominent; flowers otherwise typical. *Fruit pedicel* to 5 by 1 mm, slender, long; *calyx lobes* to 7 by 4 mm, lanceolate, subacute, reflexed at base, upcurved distally; *nut* to 15 mm  $\varnothing$ , subglobose, with 3 indistinct loculicidal grooves.

Distr. *Malesia*: Malaya (Perak, Selangor, Pahang, Trengganu).

Ecol. Local, on undulating land near coast and to 1800 m on inland ridges.

Vern. *Rēsak langgong*.

Note. Some sterile collections from the east coast closely resemble *V. sarawakensis*, so far not confirmed from Malaya.

**20. *Vatica globosa*** ASHTON, Gard. Bull. Sing. 22 (1967) 269, pl. 12; Man. Dipt. Brun. Suppl. (1968) 32, f. 5.

Twig, leaf bud and petiole persistently rufous-brown sericeous. *Twig* c. 2 mm  $\varnothing$  apically, terete, smooth, grey; stipule scar short, horizontal, obscure. *Bud* c. 2 by 2 mm, ovoid, acute. *Stipule* unknown. *Leaves* 7–18 by 3–6.5 cm, obovate, somewhat chartaceous; base narrowly cuneate; acumen to 2 cm long, slender, caudate; nerves 12–16 pairs, slender but prominent beneath with the lamina concave between them, distinctly elevated above, at 35°–60°, with many short secondary nerves; tertiary nerves reticulate; midrib prominent on both surfaces, more so beneath than above; *petiole* 7–15 mm long, terete with a distinct furrow above, drying rugulose. *Panicle* to 3 cm, terminal or axillary, frequently several in an axil, congested, ribbed or terete, persistently rufous sericeous; irregularly  $\pm$  singly branched; *bracteoles* fugaceous. *Flower bud* to 5 by 2 mm, lanceolate. *Calyx* densely vinous pubescent outside, glabrous within; corolla sparsely so, cream on opening; *appendage to connective* conical, c.  $\frac{1}{2}$  length of anther; flowers otherwise typical. *Fruit* entirely persistently rufous sericeous. *Calyx lobes* to 4 by 3 mm, equal, oblong, obtuse, reflexed. *Nut* to 20 mm  $\varnothing$ , globose, obtuse, 3-sutured.

Distr. *Malesia*: Borneo (Mukah to Niah valleys, Central Sarawak), W. Borneo (Ulu Kapuas).

Ecol. Very local, Mixed Dipterocarp forest on low hills.

**21. *Vatica lobata*** Foxw. Mal. For. Rec. 10 (1932) 276, pl. 23; BURK. Dict. (1935) 2224; SYM. Mal. For. Rec. 16 (1943) 221, f. 107.

Small tree. Young parts, calyx and ovary  $\pm$  caducous buff cinereous; leaf buds, panicles and petals outside persistently so, otherwise glabrous. *Twig* c. 2 mm  $\varnothing$ , slender, pale brown, sometimes chartaceous flaky, terete. *Buds* small, ovoid; *stipules* fugaceous. *Leaves* 7–24 by 2–9.5 cm, elliptic-lanceolate, thinly coriaceous; base  $\pm$  narrowly cuneate, subdecurent; acumen to 15 mm long, slender; nerves c. 5(–8) pairs, ascending, slender but distinctly elevated beneath, less

so above, as also the midrib; tertiary nerves laxly reticulate, hardly elevated on either surface; *petiole* 8–12 mm long, c. mm  $\varnothing$ , relatively short. *Panicle* to 5 cm long, terminal or axillary, shortly branched. *Flower buds* to 6 by 2 mm, fusiform; *appendages* very short, deltoid; *style* stoutly columnar, somewhat longer than ovary, expanding at base and at the prominent conical style; flowers otherwise typical. *Fruit pedicel* to 2 by 1 mm; *calyx lobes* to 10 by 8 mm, equal, elliptic, incrassate, smooth, lustrous, adnate to the 17 by 15 cm ovoid smooth apiculate nut.

Distr. *Malesia*: Malaya (E. coast: Trengganu to Johore).

Ecol. Local, near streams.

Vern. *Rēsak paya*, *r. laru*.

**22. *Vatica hullettii*** (RIDL.) ASHTON, Gard. Bull. Sing. 31 (1978) 21. — *Capura hullettii* RIDL. J. Str. Br. R. As. Soc. 54 (1910) 36. — *Otophora hullettii* RIDL. Fl. Mal. Pen. 1 (1922) 494; RADLK. in E. & P. Pfl. R. Heft 98 (1932) 775, cf. LEENH. Blumea 17 (1969) 88. — *V. stipulata* RIDL. J. Str. Br. R. As. Soc. 82 (1920) 172, *nom. illeg.*; Fl. Mal. Pen. 1 (1922) 244; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 76; Foxw. Mal. For. Rec. 10 (1932) 225; SYM. Mal. For. Rec. 16 (1943) 229.

Small tree. Ovary, calyx and panicle caducous pale brown puberulent, petioles persistently so. *Twigs* c. 2 mm  $\varnothing$  apically, smooth, with prominent ribs decurrent from leaf traces; stipule scars obscure, horizontal. *Buds* hidden between to 33 by 22 mm large ovate to elliptic subacute coriaceous 3–5-nerved persistent stipules. *Leaves* 9–30 by 2–9 cm, narrowly elliptic, coriaceous, frequently somewhat bullate; base cuneate; acumen to 2 cm long; nerves 8–11 pairs, slender but distinctly raised beneath, elevated above as also the midrib, arched, ascending, with short secondary nerves; tertiary nerves reticulate, slightly elevated on both surfaces; *petiole* to 3 cm long, 1–3 mm  $\varnothing$ , drying characteristically pale cream brown rugulose. *Panicle* to 15 cm long, lax, irregularly branched, slender. *Flower buds* to 12 by 2 mm; *appendages* small, deltoid; *style* longer than ovary, slender, greatly expanding into the prominent conical stigma; flowers otherwise typical. *Fruit pedicel* to 4 by 1 mm, prominent; *calyx lobes* to 20 by 14 mm, ovate, subacute, loosely enclosing the base of the nut but the sides becoming completely revolute; *nut* to 2 cm  $\varnothing$ , subglobose, verruculose, with 3 indistinct loculicidal sutures.

Distr. *Malesia*: Malaya (Negri Sembilan, Malacca, Johore).

Ecol. Rare, lowland dipterocarp forest on hills.

Note. Related to *V. albiramis* (q.v.).

**23. *Vatica pallida*** DYER, Fl. Br. Ind. 1 (1874) 302; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 121; RIDL. Fl. Mal. Pen. 1 (1922) 244; SLOOT. Bull. Jard. Bot. Btzg III, 9 (1927) 73, 103, f. 1a; Foxw. Mal. For. Rec. 10 (1932) 266; BURK. Dict. (1935) 2224; SYM. Mal. For. Rec. 16 (1943) 225, f. 107. — *Retinodendron pallidum* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 128; BURK. J. Str. Br. R. As. Soc. 81 (1920) 51, 62, 63, fig.



Small, low-branched tree. Young parts pale brown caducous puberulent, persisting on into the young fruit on calyx and ovary. *Twig* c. 1 mm  $\varnothing$  apically, slender, straight, terete, smooth, pale grey-brown. *Buds* minute. *Leaves* 6–16 by 2–5.6 cm, narrowly elliptic, thinly coriaceous; base narrowly cuneate; acumen to 2 cm long, slender, subcaudate; nerves 9–11 pairs, arched, ascending, slender, hardly elevated on either surface as also the reticulate tertiary nerves and somewhat more prominent midrib; *petiole* 5–8 mm long, short, slender. *Panicle* to 4 cm long, terminal or subterminal axillary, few branched. *Fruit pedicel* to 4 by 1 mm, slender, long; *calyx lobes* to 8 by 3 mm, lanceolate, loosely clasping the c. 1 cm  $\varnothing$  subglobose smooth mucronate nut.

Distr. *Malesia*: Malaya (Penang).

Ecol. Common in the forests on the slopes of Penang hill, to 350 m.

Vern. *Rèsak kèchil*.

Note. Closely allied to *V. philastreana* PIERRE of southern Indo-China and also to *V. lanceaefolia* BL. of Assam.

**24. *Vatica flavida*** Foxw. Mal. For. Rec. 10 (1932) 272, pl. 22; BURCK, Dict. (1935) 2223; SYM. Mal. For. Rec. 16 (1943) 220, f. 107.

Medium-sized tree. Twigs, petioles, leaf buds, midrib above, panicles and nut densely persistently tawny scabrid pubescent, leaf nervation beneath sparsely so,

calyx outside caducously so; outsides of petals densely evenly cream puberulent. *Twigs* 2–3 mm  $\varnothing$  apically, prominently ribbed at first, becoming pale brown, terete. *Buds* to 6 by 4 mm, ovoid-lanceolate, acute. *Leaves* 6–11 by 2.5–5 cm, elliptic to narrowly obovate, coriaceous; base broadly cuneate to obtuse; acumen to 1 cm long, slender, prominent; nerves 9–11 pairs, prominent beneath, distinctly depressed above with the leaf surface bullate between, arching within the margin; tertiary nerves subreticulate, distinctly elevated beneath, hardly so above; midrib stoutly prominent beneath, shallowly depressed though evident above; *petiole* 11–15 mm long. *Panicles* to 3.5 cm long, short, axillary, twice branched from the bases, many-flowered and appearing congested about the bases of the leaves. *Flower buds* to 8 by 3 mm, fusiform; *sepals* unequal, ovate-lanceolate; *corolla* pale yellow; *stamens* 15; anthers subglobose, appendages prominent, broadly deltoid; *style* columnar, slightly longer than ovary; stigma conical; flowers otherwise typical. *Fruit pedicel* to 4 mm long, prominent but hidden in the reflexed sepals; *calyx lobes* to 8 by 6 mm, equal, broadly lanceolate, becoming reflexed with the apices recurved upwards; *nut* to 10 by 10 mm, broadly ovoid to subglobose, with 3 distinct loculicidal furrows.

Distr. *Malesia*: Malaya (S. Perak).

Ecol. Rare, in forest on swampy land.

Vern. *Rèsak padi*.

## 2. Section *Sunaptea*

(GRIFF.) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 223; ASHTON, Gard. Bull. Sing. 20 (1963) 250. — *Sunaptea* GRIFF., corr. ‘*Synaptea*’ KURZ. — *Pteranthera* BL. — *Vatica* sect. *Euwatica* B. & H. Gen. Pl. 1 (1862) 192; DYER, Fl. Br. Ind. 1 (1874) 301; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 224; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 102. — *Vatica* subg. *Synaptea* (GRIFF.) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 128.

*Fruit calyx lobes* unequal, chartaceous, with 2 lobes longer than the other three, not becoming reflexed.

**25. *Vatica heteroptera*** SYM. J. Mal. Br. R. As. Soc. 19 (1941) 147, pl. 5B; Mal. For. Rec. 16 (1943) 221, f. 107.

Medium-sized tree. Young parts pale brown caducous cinereous, panicle and nut  $\pm$  persistently so. *Twig* c. 2 mm  $\varnothing$  apically, slender, rather straight, terete, smooth, pale brown. *Bud* to 2 by 2 mm, small, ovoid; *stipule* fugaceous. *Leaf* 9–20 by 3–8 cm, narrowly oblong-elliptic, thinly coriaceous; base narrowly obtuse to broadly cuneate; acumen to 2 cm long; nerves 11–14 pairs, slender but prominent beneath, evident above, arched, with or without short secondary nerves; midrib slender but prominent beneath, sharply elevated above; tertiary nerves densely subreticulate; *petiole* 11–18 mm long, c. 2 mm  $\varnothing$ , relatively short. *Panicles* to 12 cm long, terminal or axillary, rather straight; flowers unknown. *Fruit pedi-*

*cel* to 3 by 2 mm; *calyx lobes* to 2.5 by 1 cm, lanceolate, subacute, unequal but patent; *nut* to 15 mm  $\varnothing$ , to 12 mm long, depressed-globose; shortly mucronate.

Distr. *Malesia*: Malaya (Perak, Pahang).

Ecol. Locally frequent in Upper Dipterocarp forest on ridges, 1000–1300 m in the Malayan Main Range.

Vern. *Rèsak gunong*.

**26. *Vatica maritima*** SLOOT. Bull. Bot. Gard. Btzig III, 17 (1942) 245, f. 32; ASHTON, Man. Dipt. Brun. (1964) 72, f. 10; *ibid.* Suppl. (1968) 33; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 310.

Young twig, panicle, leaf bud and petiole densely shortly evenly  $\pm$  persistently cream pubescent. *Twig* to 8 mm  $\varnothing$  apically, ribbed or somewhat compressed, becoming terete, glabrous, smooth. *Bud* to 4 by 3 mm,

ovoid, subacute. *Stipule* unknown. *Leaves* 8–16 by 3–8 cm, broadly or narrowly ovate, coriaceous; base broadly cuneate to subcordate, acuminate to 1 cm long, short, broad; nerves 7–10 pairs, raised on both surfaces, more prominently so beneath, with short, slender secondary nerves; tertiary nerves reticulate; *petiole* 2–2.7 cm long, not geniculate. *Panicle* to 11 cm long, axillary, rarely terminal, lax, angular; branchlets to 1.5 cm long, short, with up to 12 close flowers; *bracteoles* to 3 by 2 mm, ovate, subacute, sparsely pubescent. *Flower bud* to 1.4 cm long; *calyx* densely pale brown, tomentose, flowers otherwise typical. *Fruit pedicel* to 4 mm long; *calyx* puberulent at base, otherwise glabrous; 2 longer lobes to 5 by 1 cm, oblong-spatulate, obtuse, base to 3 mm broad, fusing with shorter lobes forming an up to 5 mm  $\varnothing$  shallow cup adnate to the base of the fruit; 3 shorter lobes to 13 by 4 mm, lanceolate, acute. *Nut* to 7 by 7 mm, subglobose, sparsely cream pubescent; style remnant to 1 cm long, slender.

Distr. *Malesia*: Borneo (N.E. Kalimantan; Brunei; W. Sabah), also S. Philippines (Palawan).

Ecol. Very local, dry coastal hills in non-seasonal lowland forest.

Vern. *Resak laut*, *r.l. timor* (Borneo).

**27. *Vatica teysmanniana*** BURCK, Ann. Jard. Bot. Btzig 6 (1887) 230; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 133; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 314; *ibid.* ed. 2 (1927) 1131; SLOOT, Bull. Jard. Bot. Btzig III, 9 (1927) 90, f. 3. — *Synaptea teysmannii* HEIM, Rech. Dipt. (1892) 100.

Medium-sized to large tree. Twigs, leaf buds and petioles densely persistently pale fawn scabrid pubescent, midrib above and panicles  $\pm$  caducously so; parts of petals exposed in bud and ovary densely evenly persistent-puberulent, calyx and pedicel caducously so. *Twig c.* 4 by 2 mm  $\varnothing$  apically, compressed at first, becoming terete,  $\pm$  ribbed, blackish, with long  $\pm$  prominent pale horizontal somewhat descending stipule scars. *Buds* to 6 by 5 mm, ovoid, acute. *Leaves* 9.5–34 by 3–11 cm, variable in size, narrowly elliptic to lanceolate, lustrous, thickly coriaceous; margin narrowly subrevolute; base broadly cuneate to obtuse; apex shortly retuse, obtuse or to 1 cm long broadly acuminate; nerves 13–17 pairs, arched, slender but prominent beneath, less (but distinctly so) above as also the midrib, sometimes with a few short  $\pm$  obscure secondary nerves; tertiary nerves densely reticulate, distinctly elevated on both surfaces; *petiole* 13–25 mm long, *c.* 3 mm  $\varnothing$ , stout, not geniculate. *Panicles* to 15 cm long, terminal or axillary, lax, spreading, rather regularly singly or doubly branched; branchlets to 7 cm long, bearing to 7 flowers. *Flower buds* to 12 by 3 mm, large. *Fruit pedicel* to 6 mm long, slender, prominent; calyx lobes unequal; 2 longer lobes to 11 by 1.8 cm, lorate-spatulate, obtuse, *c.* 4 mm wide at base; 3 shorter lobes to 18 by 6 mm, lanceolate, acute; *nut* to 6 mm  $\varnothing$ , globose.

Distr. *Malesia*: Sumatra (E. Coast: Bengkalis), Banka.

Ecol. Mixed swamp forests.

Vern. *Resak ayër*, *r. paya*, *r. badouw*, *r. siantën*.

Note. The vegetative parts evoke *V. coriacea* of Borneo, but the fruit calyx, inflorescence and bracts at once distinguish the species.

**28. *Vatica cinerea*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 104; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 131; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 150, t. 183A; RIDL, J. Str. Br. R. As. Soc. 61 (1912) 50; Fl. Mal. Pen. 1 (1922) 243; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 312; CRAIB, Fl. Siam. Enum. 1 (1925) 140; SLOOT, Bull. Jard. Bot. Btzig III, 9 (1927) 80; Foxw. Mal. For. Rec. 10 (1932) 256; BURK, Dict. (1935) 2223; SYM. J. Mal. Br. R. As. Soc. 19 (1941) 157; Mal. For. Rec. 16 (1943) 218, f. 107. — *V. lankaviensis* RIDL, J. Str. Br. R. As. Soc. 54 (1909) 27; CRAIB, Fl. Siam. Enum. 1 (1925) 141. — *Synaptea cinerea* RIDL, Fl. Mal. Pen. 1 (1922) 243. — *Synaptea lankaviensis* RIDL, Fl. Mal. Pen. 1 (1922) 241.

Small or medium-sized tree. Twig, petiole and panicle sparsely pale pink-brown puberulent; outside of perianth and ovary densely so, caducous except on petals and ovary. *Twig c.* 1 mm  $\varnothing$  apically, slender, much branched, pale brown, terete, smooth. *Bud* small, ovoid; *stipules* fugaceous. *Leaf* 5.5–14 by 1.5–5 cm, elliptic-lanceolate, thinly coriaceous; base cuneate, apex acute to subacuminate; nerves 9–11 pairs, arched, ascending, slender and hardly more elevated beneath than above as also the midrib and densely reticulate tertiary nerves; *petiole* 5–11 mm long, slender. *Panicle* to 9 cm long, terminal or axillary, irregularly branched. *Flower bud* to 8 by 3 mm, lanceolate; *appendages* very short; *style* columnar, slender, somewhat longer than ovary, capitate; stigma large, conical; flowers otherwise typical. *Fruit pedicel* to 3 by 1 mm, slender, prominent; *calyx* united into an up to 7 mm  $\varnothing$  cup at base adnate to the basal  $\frac{1}{2}$  of the ovary; 2 longer lobes to 7 by 1.8 cm, spatulate, obtuse, *c.* 3 mm wide at base; 3 shorter lobes to 15 by 5 mm, lanceolate, acute; *nut* to 7 mm  $\varnothing$ , subglobose, with filiform style remnant.

Distr. South Tenasserim, Peninsular Thailand, and in *Malesia*: Malaya (Kedah, Perlis, Langkawi).

Ecol. Dry ridges, headlands, limestone and other rocky places, in *Schima*-bamboo forests, to 600 m.

Vern. *Resak*, *r. laut*.

**29. *Vatica odorata*** (GRIFF.) SYM. J. Mal. Br. R. As. Soc. 19 (1941) 156; Mal. For. Rec. 16 (1943) 224, f. 107; ASHTON, Gard. Bull. Sing. 22 (1967) 263; *ibid.* 31 (1978) 23.

*a. ssp. odorata*. — *Hopea faginea* WALL. Cat. (1828) 963, *nomen*. — *Shorea pinangiana* WALL. Cat. (1828) 157, *nomen*; KURZ, J. R. As. Soc. Beng. Sc. 43, 2 (1874) 96, *nomen pro syn.*; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 105, *nomen pro syn. sub V. faginea*. — *Synaptea odorata* GRIFF. Notul. 4 (1854) 516; Ic. Pl. As. (1854) t. 585A, f. 5; HEIM, Rech. Dipt. (1892) 113. — *Hopea grandiflora* WALL. [Cat. (1828) 958, *nomen*] ex A. DC.



Prod. 16, 2 (1868) 634. — *Synaptea grandiflora* KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 65; PIERRE, For. Fl. Coch. 4 (1891) t. 240–242. — *Anisoptera odorata* KURZ, Flora 30 (1872) 191; J. R. As. Soc. Beng. Sc. 43, 2 (1874) 96; Fl. Burma 1 (1877) 112. — *V. grandiflora* DYER, Fl. Br. Ind. 1 (1874) 301; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 101; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 129; Ind. Trees (1906) 72; FOXW. Mal. For. Rec. 10 (1932) 260. — *V. faginea* DYER, Fl. Br. Ind. 1 (1874) 301; KURZ, J. R. As. Soc. Beng. Sc. 43, 2 (1874) 96; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 105; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 129; Ind. Trees (1906) 72; BRANDIS & GILG in E. & P. Pfl. Fam. 3, 6 (1895) 270; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 391; RIDL. Fl. Mal. Pen. 1 (1922) 242, *p.p.*; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 265; HEYNE, Nutt. Pl. ed. 2 (1927) 1129; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 81; FOXW. Mal. For. Rec. 10 (1932) 260. — *V. astrotricha* HANCE, J. Bot. 14 (1876) 241; LANESS. Pl. Util. Colon. Fr. 1 (1886) 299; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 130; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 270; FISCHER, Kew Bull. (1926) 457; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 80. — *V. dyeri* PIERRE ex LANESS. Pl. Util. Colon. Fr. 1 (1886) 299; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 106; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 128, t. 3, f. 15–17; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 387, 392, fig.; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 82; FOXW. Mal. For. Rec. 10 (1932) 258; BURK. Dict. (1935) 2223. — *Synaptea astrotricha* PIERRE, For. Fl. Coch. 4 (1891) t. 240; HEIM, Rech. Dipt. (1892) 118. — *Synaptea dyeri* PIERRE, For. Fl. Coch. 4 (1891) t. 241; RIDL. Fl. Mal. Pen. 1 (1922) 240. — *Synaptea faginea* PIERRE, For. Fl. Coch. 4 (1892) 242; RIDL. Fl. Mal. Pen. 1 (1922) 242. — *V. curtisii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 105; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 131; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 151, t. 183B; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 81; FOXW. Mal. For. Rec. 10 (1932) 257; BURK. Dict. (1935) 223. — *V. fleuryana* TARDIEU, Not. Syst. 10 (1942) 137; Fl. Gén. I.-C. Suppl. 1 (1943) 359, f. 39 (9–16). — *V. tonkinensis* [CHEVALIER, Bull. Ec. Indochine 20 (1918) 799, *nomen*] TARDIEU, Not. Syst. 10 (1942) 137; Fl. Gén. I.-C. Suppl. (1943) 357, f. 39 (1–8).

Young twig, raceme, leaf bud, stipule, and petiole ± densely persistently pale yellowish brown to fulvous tomentose. Twig 1.5 mm  $\varnothing$  apically, terete, glabrous, rugose, frequently finely flaked. Bud to 2 by 1.5 mm, ovoid, obtuse. Stipule to 8 by 2 mm, oblong, obtuse, caducous. Leaves 8–16 by 2.7–5.5 cm, narrowly elliptic to ovate, thinly coriaceous, base obtuse or cuneate; acumen to 8 mm long; nerves 11–15, prominent beneath; midrib prominent beneath, applanate above or slightly depressed; petiole 8–12 mm long. Panicle to 7 cm long; terminal or axillary singly branched. Flower bud to 8 mm long; calyx densely shortly pale grey-brown tomentose; appendage to connective short, obtuse; flowers otherwise typical. Fruit pedicel c. 3 mm long, slender. Fruit calyx at first powdery tomentose, glabrescent, united in an

up to 5 mm deep, to 8 mm  $\varnothing$ , cup at base and fused to nut; 2 longer lobes to 5.5 by 1.5 cm, thin, spatulate, obtuse, base to 2.5 mm broad, 3 shorter lobes to 14 by 4 mm, hastate, acute. Nut to 7 mm long and  $\varnothing$ , globose, shortly densely yellow-brown to fulvous tomentose, the basal half adnate with the calyx cup; style remnant to 2 mm long, linear.

Distr. Tenasserim, Thailand, Indochina, S. China (Kwangsi), and in Malesia: Malaya (Negri Sembilan & Pahang northwards), Borneo (Tawau, S.E. Borneo).

Ecol. Scattered on dry ridges in coastal forests in ± seasonal areas.

Vern. *Resak runting késat*.

**b. ssp. mindanensis** (FOXW.) ASHTON, Gard. Bull. Sing. 22 (1967) 263; Man. Dipt. Brun. (1964) 75 (as *V. odorata*; f. 10); *ibid.* Suppl. (1968) 34 (*ditto*); Gard. Bull. Sing. 31 (1978) 24. — *V. mindanensis* FOXW. in Elmer, Leaf. Philip. Bot. 6 (1913) 1957; Philip. J. Sc. 13 (1918) Bot. 196; *ibid.* 67 (1938) 327; MERR. En. Philip. 3 (1923) 102; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 71; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 313. — *V. sorsogonensis* FOXW. Philip J. Sc. 13 (1918) Bot. 196. — *V. aerea* SLOOT. Bull. Bot. Gard. Btzig III, 17 (1941) 133, f. 19.

Differing from *ssp. odorata* in the 15–20 mm long geniculate petiole and leaf drying greyish rather than yellow-brown.

Distr. Malesia: Borneo (Kapas hinterland; Sarawak to Crocker range; Tawau); Philippines (Luzon, Leyte, Mindanao).

Ecol. Common on ridges between 1000–1200 m, in non-seasonal areas.

Vern. *Resak biabas* (Borneo).

**30. *Vatica compressa*** ASHTON, Gard. Bull. Sing. 22 (1967) 267, pl. 10; Man. Dipt. Brun. Suppl. (1968) 30, f. 5.

Young parts (except stipule within) evenly pale pink-brown pubescent, caducous except on leaf bud and stipule outside. Twig c. 3 by 1 mm  $\varnothing$ , compressed, smooth; stipule scars c. 2 mm long at first, pale, horizontal, prominent. Bud c. 3 by 3 mm, ovoid, acute, compressed. Leaves 11–19 by 5–8.5 cm, ovate-elliptic, coriaceous; base obtuse; acumen to 1 cm long; nerves 10–15 pairs, slender, only slightly raised beneath, less so above, arched, at c. 50°, with short indistinct secondary nerves; tertiary nerves scalariform; midrib prominent beneath, applanate or raised above; petiole 15–23 mm long. Panicle to 7 cm long, somewhat compressed, sparsely pale pink-brown pubescent, irregularly singly or doubly branched. Flower bud to 9 by 4 mm, lanceolate; calyx densely pale fulvous pubescent; corolla densely pubescent on parts exposed in bud; flowers otherwise typical. Fruit pedicel to 8 mm long, slender, pubescent. Calyx puberulent to glabrescent; 2 longer lobes to 6.5 by 1 cm, lorate, ± obtuse, c. 3 mm broad at base; 3 shorter lobes to 20 by 6 mm, deltoid, acute, revolute. Nut to 5 mm  $\varnothing$ , shortly ovoid, densely shortly buff pubescent; style remnant to 3 mm long glabrous.

Distr. *Malesia*: Borneo (Sarawak W. of Lupar valley).

Ecol. Local in Heath forest, often with impeded drainage.

**31. *Vatica congesta*** ASHTON, Gard. Bull. Sing. 22 (1967) 268, pl. 11; Man. Dipt. Brun. Suppl. (1968) 31, f. 5.

Young twigs, buds, stipules and petioles densely shortly pale ocherous-brown scabrid pubescent, leaf beneath and midrib above towards base sparsely so. *Twig* c. 3 mm  $\varnothing$  towards apex, stout, at first angular, rugose, becoming striated and chartaceous flaky. *Bud* to 4 by 3 mm, broadly ovoid-conical, acute. *Stipule* to 8 by 3 mm, narrowly deltoid, acute. *Leaves* 8–22 by 3.5–8 cm, oblong-elliptic to obovate, thickly coriaceous, subacuminate, obtuse or retuse; margin revolute; base obtuse; nerves 7–11 pairs, slightly raised above, stout and prominent beneath, at 40°–65°; tertiary nerves prominent beneath, less so above, reticulate; midrib hardly raised above, stout, prominent, striated, beneath; *petiole* 1.2–2.5 cm long, stout, rugulose. *Panicle* to 3 cm long, angular, densely shortly ocherous-brown scabrid tomentose, axillary to ramiflorous, fascicled, short, and congested; singly branched, branchlets to 1.8 cm long. *Flowers* distichous; *bud* to 8 by 3 mm; *calyx lobes* densely shortly ocherous-brown tomentose, deltoid, acute, somewhat spreading in bud; *petals* lorate, obtuse, densely pubescent on both surfaces; *appendage to connective* short, bifid; *style* short, sericeous; flowers otherwise typical. *Fruit pedicel* sparsely shortly ocherous-brown scabrid tomentose, fruit otherwise glabrous. *Pedicel* to 4 mm long, slender. 2 longer *calyx lobes* to 12 by 2.2 cm, lorate, obtuse, prominently recurved. *Nut* to 12 by 8 mm, ellipsoid, glabrous; *style* remnant to 6 mm long, slender.

Distr. *Malesia*: Borneo (W. and Central Sarawak; W. Kalimantan: Lower Kapuas).

Ecol. Rare, low hills, Mixed Dipterocarp forest.

**32. *Vatica coriacea*** ASHTON, Gard. Bull. Sing. 19 (1962) 314, pl. 30; Man. Dipt. Brun. (1964) 68, f. 10; *ibid.* Suppl. (1968) 31.

Young twig, panicle, leaf bud, stipule and petiole densely shortly ocherous pubescent, caducous on all but bud. *Twig* to 5 mm  $\varnothing$  apically, stout, ribbed, glabrous, smooth. *Bud* to 7 by 5 mm, ovoid, subacute. *Stipule* to 13 by 5 mm, hastate, subacute. *Leaves* 6.5–15 by 2.2–6 cm, thickly coriaceous, obovate,  $\pm$  strongly cupped towards margin; base narrow, obtuse or cuneate; apex obtuse to retuse; nerves 10–11 pairs, slightly raised on both surfaces, indistinct, curved, at 50°–60°, with short slender secondary nerves; midrib stout, prominent, terete beneath, slightly raised above; *petiole* 1–1.5 cm long. *Panicle* to 20 cm long, axillary or terminal, singly branched; limits of inflorescence ill-defined, often bearing leaf-like bracts. *Flowers* to 1.8 cm long; *calyx* densely shortly pale grey-brown pubescent; flowers typical. *Fruit pedicel* to 7 mm long, slender; *calyx* shortly persistently pubes-

cent outside, glabrescent within, free to base; 2 longer lobes to 7 by 2.3 cm, oblong, obtuse, to 3.5 mm broad at base; 3 shorter lobes to 2 by 6 mm, hastate, acute. *Nut* to 8 mm  $\varnothing$ , and globose, puberulent or glabrescent, rugulose, frequently crowned with an up to 2 mm long linear style remnant.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Ecol. Locally frequent, Heath forest on podsols on coastal raised beaches, and on rentzinas over limestone in the west.

Vern. *Resak daun tēbal*.

**33. *Vatica javanica*** SLOOT, Bull. Jard. Bot. Btzg III, 16 (1940) 451, f. 9; BACKER & BAKH. f. Fl. Java 1 (1963) 332; ASHTON, Gard. Bull. Sing. 31 (1978) 22.

**a. *ssp. javanica*.**

Medium-sized to large tree. Twigs, petioles, panicles, pedicels and base of calyx outside densely persistently tawny scabrid pubescent; leaf undersurface frequently more sparsely so; fruit calyx caducously so. *Twig* c. 3 mm  $\varnothing$  apically, stout,  $\pm$  compressed at first and ribbed, becoming terete, smooth. *Leaf bud* to 8 by 5 mm, ovoid, acute. *Leaves* 13–24 by 6–10 cm, elliptic-oblong or obovate, applanate, thinly coriaceous; base obtuse or subcordate; acumen to 1.5 cm long,  $\pm$  prominent; nerves 22–25 pairs,  $\pm$  straight, ascending,  $\pm$  distinctly branching and arching within the margin forming a looped intramarginal nerve, stoutly prominent beneath, elevated above as also the midrib, without distinct secondary nerves; tertiary nerves subscalariform, prominent beneath, evident above; *petiole* 2–3 cm long, c. 3 mm  $\varnothing$ , stout. *Panicles* to 12 cm long, terminal or axillary, rather straight, irregularly doubly branched. *Flower buds* to 11 by 4 mm, fusiform; *sepals* narrowly lanceolate, unequal; *anthers* subglobose; appendages very short; *style* c. 1½ times as long as ovary, expanding distally; stigma conical; flowers otherwise typical. *Fruit pedicel* to 8 mm long, slender; *calyx lobes* unequal, free to base; 2 longer lobes to 7.5 by 1.7 cm, spatulate, obtuse; 3 shorter lobes to 30 by 7 mm, lanceolate, slender; *nut* globose, unknown at maturity.

Distr. *Malesia*: W. Java (Priangan Regencies, once collected).

Ecol. Primary forest, 950 m.

**b. *ssp. scaphifolia*** (KOSTERM.) ASHTON, Gard. Bull. Sing. 31 (1978) 22. — *V. scaphifolia* KOSTERM. New & Crit. Mal. Pl. 3 (1955) 2, f. 1.

*Leaves*  $\pm$  prominently boat-shaped with the lower surface concave,  $\pm$  distinctly bullate between the nerves, the nerves and sometimes tertiary nerves consequently  $\pm$  channelled above.

Distr. *Malesia*: S.E. Borneo (Samarinda, Balikpapan).

Ecol. Locally frequent in Lowland Dipterocarp forest on well drained undulating land.

**34. *Vatica brunigii*** ASHTON, Gard. Bull. Sing. 22



(1967) 267, pl. 9; Man. Dipt. Brun. Suppl. (1968) 30, f. 5.

Young twigs, buds, stipules, petioles, and leaf beneath persistently shortly yellowish buff scabrid pubescent; leaf above fugaceous flocculent tomentose. *Twig* c. 2 mm  $\varnothing$  towards apex, slender, terete. *Bud* to 3 by 2 mm, ovoid-conical, obtuse. *Stipule* to 5 by 2 mm, lorate, obtuse; acumen to 1 cm long; nerves 9–12 pairs, unraised above, slender but prominent beneath, at 65°–80°; midrib hardly raised above, prominent beneath; tertiary nerves scalariform, obscure above, slightly raised beneath; *petiole* 8–15 mm long. *Panicle* to 12 cm long, terete or angular, densely shortly persistently ocherous scabrid tomentose, terminal or axillary but confined to young twigs; singly (if axillary) or doubly (if terminal) branched, branchlets to 6 cm long; bracteoles to 3 by 1 mm, elliptic, sparsely pubescent. Flowers distichous; *flower buds* to 8 by 2 mm, ellipsoid; calyx densely shortly ocherous-grey pubescent; *petals* narrowly oblong, obtuse, sparsely pubescent outside, glabrescent within; appendage to connective short, erect, exceeding apex of anther; *style* columnar, longer than ovary; flowers otherwise typical. *Fruit pedicel* and *calyx* sparsely buff pubescent, nut densely scabridly so. *Pedicel* to 3 mm long, slender; 2 longer *calyx lobes* to 6.5 by 1.5 cm, lorate to spatulate, obtuse; 3 shorter lobes to 15 by 6 mm, ovate, acute, slightly recurved. *Nut* to 9 by 7 mm, ovoid, subacute.

Distr. *Malesia*: E. Sumatra (P. Musala, Lower Langkat, Riouw), Borneo (Pontianak, Sarawak, Brunei).

Ecol. Heath forest on shallow podsols, terraces, plateaux and cuestas, coastal areas and dry ridges to 700 m.

**35. *Vatica pachyphylla* MERR.** Philip. J. Sc. 13 (1918) Bot. 311; En. Philip. 3 (1923) 102; Foxw. Philip. J. Sc. 67 (1938) 325.

Twigs, petioles, panicle, parts of petals exposed in bud and ovary densely persistently pale tawny somewhat scurfy pubescent, leaf undersurface and midrib above  $\pm$  caducously so. *Twig* c. 3 mm  $\varnothing$ , stout, rugose, with prominent raised petiole scars. *Leaves* 7–15 by 2.8–7.5 cm, elliptic, coriaceous, dull beneath, lustrous above; base  $\pm$  broadly cuneate, acumen to 1 cm long, slender, prominent, nerves 10–11 pairs, ascending at c. 45°, rather straight, prominent beneath, somewhat less so above, as also the midrib; tertiary nerves densely reticulate, distinctly  $\pm$  equally elevated on both surfaces; *petiole* 17–23 mm long. *Panicle* to 7 cm long, axillary, stout, irregularly doubly branched. *Flower bud* to 9 by 3 mm; sepals narrowly deltoid, unequal; anthers narrowly oblong, tapering; appendages slender but prominent; *style* slightly longer than ovary, expanding distally, capitate; *stigma* conical; flower otherwise typical. *Fruit pedicel* to 4 mm long, slender; 2 longer *calyx lobes* to 7 by 1.3 cm, broadly spatulate, obtuse, c. 5 mm broad at base; 3 shorter lobes to 20 by 8 mm, narrowly elliptic-lanceolate, acute; *nut* to 8 mm  $\varnothing$ , broadly ovoid or subglobose, mucronate.

Distr. *Malesia*: Philippines (E. Luzon, Polillo).

Ecol. Scattered in non-seasonal evergreen dipterocarp forests below 80 m.

Vern. *Hagakhae na itim*, *dadiangao*, *tamahuan* (Camarines), *manapo* (Tayabas), *yacal* (Polillo), *hanic* (Cagayan).

**36. *Vatica obovata* SLOOT.** [Med. Proefst. Boschw. 2 (1925) 132, *nomen*] Bull. Jard. Bot. Btzig III, 9 (1927) 89, f. 2.

Medium-sized tree. Twigs, petiole, leaf buds, stipules, nut, fruit pedicel and midrib and nerves beneath densely  $\pm$  persistently evenly pale brown puberulent, leaf undersurface and fruit calyx sparsely so. *Twig* c. 2 mm  $\varnothing$  apically, ribbed at first, becoming terete. *Leaf bud* to 5 by 4 mm, ovoid, acute; *stipule* to 8 by 3 mm, lanceolate, fugaceous. *Leaves* 8–15 by 9.5–7 cm, elliptic to obovate, thinly coriaceous; margin narrowly subrevolute; base narrowly obtuse; acumen to 1.5 cm long, downcurved and twisting over on pressing; nerves 11–14 pairs, arched, slender but prominent beneath, evident and slightly elevated above as also the midrib; tertiary nerves subscalariform, very slender but slightly elevated on both surfaces; *petiole* 15–20 mm long, slender, prominently geniculate. Flowers and inflorescences unknown. *Fruit pedicel* to 5 mm long; *calyx lobes* unequal, 2 longer lobes to 6.5 by 1.5 cm, spatulate, subacute, c. 5 mm broad at base; 3 shorter lobes to 1.5 by 6 mm, lanceolate-acuminate; *nut* to 6 mm  $\varnothing$ , subglobose.

Distr. *Malesia*: Sumatra (Palembang).

Vern. *Resak lingga*.

**37. *Vatica borneensis* BURCK,** Ann. Jard. Bot. Btzig 6 (1887) 230; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 133; MERR. En. Born. (1921) 408; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 87; BROWNE, For. Trees Sarawak & Brunei (1955) 100; ASHTON, Gard. Bull. Sing. 20 (1963) 252; Man. Dipt. Brun. (1964) 68, f. 10; *ibid.* Suppl. (1968) 30. — *V. urbanii* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 956; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 133; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 77. — *Sunaptea borneensis* HEIM, Rech. Dipt. (1892) 116. — *Sunaptea urbanii* HEIM, Rech. Dipt. (1892) 115. — *V. beccarii* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 133, *nomen in syn.*

Young twig, panicle, leaf bud, midrib beneath and petiole  $\pm$  persistently densely evenly pink-brown puberulent. *Twig* to 1.5 mm  $\varnothing$  apically, slender, ribbed or terete, becoming smooth or rugulose. *Bud* to 2 by 1.5 mm, ovoid, acute. *Stipule* unknown. *Leaves* 6–10 by 2.5–5 cm, elliptic, coriaceous; base cuneate; acumen to 6 mm long; nerves 7–9 pairs, hardly raised on either surface, at 30°–35°, strongly curved, with short secondary nerves; midrib slender, prominent beneath,  $\pm$  applanate above; *petiole* 1.5–2.5 cm long, slender, not swollen distally. *Panicle* to 5 cm long, axillary, terete, densely pink-brown pubescent. *Flower bud* to 1 cm long; densely pink-brown pubescent; flowers otherwise typical. *Fruit pedicel* c. 5 mm long,



Fig. 46. Close-up of inflorescence of *Vatica bantamensis* (HASSK.) B. & H. ex MIQ. Cult. Hort. Bog. July 1955.

slender; *calyx* caducous rufous powdery tomentose; lobes free to base; 2 longer lobes to 5.5 by 1.5 cm, oblong-spatulate, to 4 mm broad at the non-revolute base; 3 shorter lobes to 18 by 7 mm, unequal, narrowly ovate, tapering, acute, slightly constricted at base, not revolute. *Nut* to 1 cm  $\varnothing$ , globose, puberulent to glabrous, crowned by a short acute style remnant.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Ecol. Leached sandy soils, coastal hills and inland ridges to 900 m; pole forest.

Vern. *Resak kēmudi*.

**38. *Vatica bantamensis*** (HASSK.) B. & H. ex MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85, cf. B. & H. Gen. Pl. 1 (1862) 192; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 231, t. 28; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 132; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 270; K. & V. Bijdr. 5 (1900) 129; KOORD. Exk. Fl. Java 2 (1912) 622; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 265; SLOOT, Bull. Jard. Bot. Btzig III, 9 (1927) 87; BACKER & BAKH. f. Fl. Java 1 (1963) 332. — *Anisoptera bantamensis* HASSK. Retzia 1

(1855) 140; WALP. Ann. 4 (1857) 336; MIQ. Fl. Ind. Bat. 1, 2 (1859) 501; DC. Prod. 16, 2 (1868) 615. — *Synaptea bantamensis* KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 65; PIERRE, For. Fl. Coch. 4 (1892) t. 258; HEIM, Rech. Dipt. (1892) 113. — **Fig. 46.**

Medium-sized tree, to 30 m. Young parts densely evenly pale ochraceous buff puberulent, persistently so on ovary, panicle, calyx, and parts of petals exposed in buds; becoming sparse or glabrous on fruit calyx. *Twig* c. 2 mm  $\varnothing$  apically, terete,  $\pm$  rugulose. *Buds* minute. *Leaves* (4.5–)7.5–18 by (1.8–)3.5–7.5 cm, elliptic or lanceolate, coriaceous,  $\pm$  lustrous; base cuneate; acumen to 1 cm long, slender; nerves 9–11 pairs, slender, arched, ascending, distinctly and almost equally elevated on both surfaces as also the short  $\pm$  obscure secondary and densely reticulate tertiary nerves; midrib prominent beneath, distinctly but less prominently elevated above; *petiole* (10–)14–22 mm long, slender, distinctly geniculate. *Panicle* to 7 cm long, terminal or axillary, irregularly doubly branched. *Flower bud* to 9 by 3 mm, fusiform; sepals unequal; anthers narrowly oblong, tapering; appendage very short, conical; style longer than ovary, columnar, expanding from base; stigma shortly conical; flowers otherwise typical. *Fruit pedicel* to 5 mm long, slender; calyx lobes unequal, united into a shallow, to 5 by 10 mm cup at base adnate to the nut; 2 longer lobes to 9 by 2.5 cm, broadly spatulate, obtuse, c. 6 mm broad at base; 3 shorter lobes to 25 by 9 mm, lanceolate, narrowly subacuminate; *nut* to 10 mm  $\varnothing$ , subglobose.

Distr. *Malesia*: W. Java (S.W. Bantam: Udjong Kulon).

Ecol. Rare, evergreen forests.

**39. *Vatica mangachapoi*** BLCO, Fl. Filip. ed. 1 (1837) 401; DC. Prod. 16, 2 (1868) 623; VIDAL, Synopsis (1883) t. 15B, f. 1–6; Rev. Pl. Vasc. Philip. (1886) 61; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 134; MERR. Publ. Govt. Lab. Philip. 27 (1905) 22; Philip. J. Sc. 1 (1906) Suppl. 98; Sp. Blanc. (1918) 272; En Philip. 3 (1923) 101; WHITFORD, Philip. Bur. For. Bull. 10, 2 (1911) 76, t. 81; Foxw. Philip. J. Sc. 6 (1911) Bot. 282; *ibid.* 13 (1918) Bot. 196; *ibid.* 67 (1938) 321; REYES, Philip. J. Sc. 22 (1923) 320; SLOOT, Bull. Jard. Bot. Btzig III, 9 (1927) 94; in Merr. Pl. Elm. Born. (1929) 205; BROWNE, For. Trees Sarawak & Brunei (1955) 101; ANDERSON, Gard. Bull. Sing. 20 (1963) 159; ASHTON, *ibid.* 20 (1963) 253; Man. Dipt. Brun. (1964) 71, f. 10; *ibid.* Suppl. (1968) 33; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 310, f. 54; ASHTON, Gard. Bull. Sing. 31 (1978) 22.

**a. ssp. *mangachapoi*.** — *Mocanera mangachapoi* BLCO, Fl. Filip. ed. 1 (1837) 450. — ?*V. sinensis* (non GMEL.) BLCO, Fl. Filip. ed. 1 (1837) 401; *ibid.* ed. 2 (1845) 280; *ibid.* ed. 3, 2 (1878) 156, 'chinensis'; DC. Prod. 16, 2 (1868) 623. — *V. apteranthra* BLCO, Fl. Filip. ed. 2 (1845) 281; *ibid.* ed. 3, 2 (1878) 156. — *Dipterocarpus mangachapoi* BLCO, Fl. Filip. ed. 2 (1845) 313; *ibid.* ed. 3, 2 (1878) 216; DC. Prod. 16, 2 (1868) 614. — *Shorea*



*mangachapoi* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 34; DC. Prod. 16, 2 (1868) 632; WALP. Ann. 4 (1857) 518; F.-VILL. Nov. App. (1880) 21. — *Pteranthera sinensis* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 30. — *Pteranthera mangachapoi* BL. *l.c.* — *Anisoptera mangachapoi* DC. Prod. 16, 2 (1868) 616. — *V. scaphula* (non DYER) F.-VILL. Nov. App. (1880) 21. — *V. bureavi* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 955; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 133, t. 3, f. 20–21; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 76. — *Synaptea bureavi* HEIM, Rech. Dipt. (1892) 114. — *V. reticulata* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 106, non (THW.) A. DC. 1868; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 131; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 83; FOXW. Mal. For. Rec. 10 (1932) 259, *p.p.*; BURK. Dict. (1935) 2224. — *Cotylelobium philippinense* HEIM ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 134, *nomen in syn.* — *Synaptea reticulata* RIDL. Fl. Mal. Pen. 1 (1922) 243. — *V. whitfordii* FOXW. Philip. J. Sc. 67 (1938) 322, pl. 8. — *V. patula* SYM. J. Mal. Br. R. As. Soc. 19, 2 (1941) 148, pl. 5A; Mal. For. Rec. 16 (1943) 29, f. 107.

Young twig, panicle, petiole, leaf bud, and stipule shortly densely cream pubescent,  $\pm$  caducous on all but bud and panicle. *Twig* to 1.5 mm  $\varnothing$  apically, smooth. *Leaf bud* to 2 by 1.5 mm, ovoid, obtuse. *Stipule* to 5 by 2 mm, narrowly oblong, subacute. *Leaves* 6–11 by 2.7–5 cm, coriaceous, elliptic; base cuneate; acumen to 7 mm long; nerves 7–9 pairs, slender, hardly raised on either surface, slightly curved, at 45°–60°; no distinct secondary nerves; midrib rounded beneath, raised above; *petiole* 5–11 mm long, short. *Panicle* to 14 cm long, terete, singly or doubly branched, terminal or axillary. *Flower buds* to 1.2 cm long; calyx shortly densely cream-buff pubescent; *appendage to connective* sharply acute; flowers otherwise typical. *Fruit pedicel* to 4 mm long, slender. *Calyx* glabrous; 2 longer lobes to 5.5 by 1.5 cm, spatulate, obtuse; base to 3 mm broad, free to pedicel; 3 shorter lobes to 10 by 4 mm, lanceolate, acute. *Nut* to 4 by 6 mm, subglobose, glabrescent; style remnant, short, abrupt.

Distr. Peninsular Thailand, in *Malesia*: N. Malaya (N. Perak and Trengganu northwards), Borneo (Sarawak and Brunei; E. Sabah), Philippines.

Ecol. Common, becoming gregarious, especially on dry ridges to 800 m, in more seasonal parts of range; confirmed to Heath forest on podsols and shallow peats below 400 m near coast in W. and Central Borneo.

Vern. *Rēsak julong* (Malaya), *r. bajau* (Sabah), *narig, karig* (Philippines).

**b. ssp. obtusifolia** (ELMER) ASHTON, Gard. Bull. Sing. 31 (1978) 23. — *V. obtusifolia* ELMER, Leaf. Philip. Bot. 4 (1912) 1471; FOXW. Philip. J. Sc. 13 (1918) Bot. 196; *ibid.* 67 (1938) 323; MERR. En. Philip. 3 (1923) 102.

*Leaf* small, thickly coriaceous, obtuse to subacuminate. *Panicle* not exceeding 6 cm long.

Distr. *Malesia*: S.W. Philippines (Palawan), N. Borneo (E. Sabah).

Ecol. Rocky exposed ridges and plateaux, very local.

Note. A species with much local variation, especially in the Philippines. Forms approaching both *V. odorata* ssp. *mindanensis* and *V. pachyphylla* occur and suggest hybridisation.

**40. *Vatica parvifolia*** ASHTON, Gard. Bull. Sing. 19 (1962) 316, pl. 31; Man. Dipt. Brun. (1964) 76, f. 10; *ibid.* Suppl. (1968) 35.

Young twig, panicle, leaf bud, and petiole densely ferruginous powdery tomentose, stipule sparsely so. *Twig* to 1 mm  $\varnothing$  apically, much branched, becoming glabrous, smooth. *Bud* to 3 by 1.5 mm, ovoid, subacute. *Stipules* to 5 by 1 mm, linear, caducous. *Leaves* 2.8–6 by 1–2.3 cm, coriaceous, narrowly ovate to lanceolate; base obtuse; acumen to 1 cm long, caudate; nerves *c.* 8 pairs, indistinct, unraised, strongly curved, at 60°–75°; midrib slender, prominent beneath, applanate above; *petiole* 6–9 mm long. *Panicle* to 2 cm long, terminal or axillary, terete, singly branched. *Flower bud* to 6 mm long, small; *calyx* grey-brown pubescent; flowers otherwise typical. *Fruit pedicel* to 3 mm long, slender. *Fruit calyx* glabrescent but for the persistently puberulent base, lobes free to the pedicel; longer lobes to 6 by 0.7 cm, subequal, oblong, narrowly obtuse, revolute above the abruptly constricted base; 3 shorter lobes to 10 by 7 cm, subequal, broadly ovate, acute, cordate at base, prominently revolute. *Nut* to 5 by 3.5 mm, broadly ovoid, obtuse, shortly fulvous pubescent.

Distr. *Malesia*: Borneo (Sarawak and Brunei).

Ecol. Rare, Heath forest below 600 m.

Vern. *Rēsak kērangas padi*.

**41. *Vatica rynchocarpa*** ASHTON, Gard. Bull. Sing. 22 (1967) 270, pl. 14; Man. Dipt. Brun. Suppl. (1968) 36. — *V. sp.* ASHTON, Man. Dipt. Brun. (1964) 80.

Young twig, raceme, leaf bud, stipule, and petiole shortly sparsely grey puberulent, glabrescent. *Twig* to 1 mm  $\varnothing$  apically, slender, terete, becoming smooth. *Bud* to 1.5 by 1 mm, conical, subacute. *Stipule* to 2.5 mm long, narrowly hastate, acute, fugaceous. *Leaves* 5–8.5 by 1.3–2.5 cm, narrowly elliptic to lanceolate, thinly coriaceous; base obtuse; acumen to 1 cm long, narrow; nerves 10–14 pairs, slender, curved near the margin, hardly raised beneath, at 75°–85°, well spaced, with short obscure secondary nerves; midrib slender, raised beneath, slightly depressed, especially towards the base, above; *petiole* to 4 mm long, short, slender. *Flowers* unknown; *panicle* to 3 cm long, terminal or axillary, singly branched, pale brown puberulent. *Fruit pedicel* to 7 mm long, slender; *calyx* entirely glabrous, lobes free to base; 2 longer lobes to 6.2 by 1.4 cm, chartaceous, spatulate, narrowly obtuse, to 2.5 mm broad at base; 3 shorter lobes to 15 by 2.5 mm, hastate, acute. *Nut* to 18 by 8 mm, ovoid, glabrous, drying black; style remnant to 4 mm long, linear.

Distr. *Malesia*: Borneo (from Kapuas and Rejang valleys north-eastwards to S.E. Sabah).

Ecol. Locally frequent on clay alluvium river banks.

**42. *Vatica endertii*** SLOOT. Bull. Bot. Gard. Btzig III, 18 (1942) 248, f. 34; ASHTON, Man. Dipt. Brun. Suppl. (1968) 32, f. 5.

Young twig, bud, petiole and occasionally nervation beneath shortly pale grey-brown caducous puberulent. *Twig* c. 1 mm  $\varnothing$  apically, terete, much branched, at first striated, becoming smooth; stipule scars short, obscure. *Bud* to 2 by 2 mm, subglobose. *Stipule* fugaceous. *Leaves* 4.8–14 by 1.7–5.5 cm, narrowly oblong to obovate or rarely lanceolate, chartaceous; margin revolute; base cuneate; acumen to 1 cm long, slender; nerves 11–14 pairs, unraised above, prominent beneath, at 55°–60°, without secondary nerves; tertiary nerves scalariform, slender but elevated beneath; midrib hardly raised above, prominent beneath; *petiole* 8–20 mm long. *Flowers* unknown. *Panicle* to 3 cm long, singly branched, terete, striated, shortly evenly persistently grey-brown puberulent. *Fruit pedicel* to 8 mm long, slender. *Calyx* glabrescent; 2 longer lobes to 8 by 2 cm, oblong-spatulate, obtuse, c. 3 mm broad above the base; 3 shorter lobes to 20 by 6 mm, lanceolate, acute, to c. 3 mm broad at base, hardly recurved. *Nut* to 6 by 5 mm, subglobose, buff sericeous.

Distr. *Malesia*: Borneo (Central Sarawak, Tawau area, W. Kutei, Sangkulirang).

Ecol. Mixed Dipterocarp forest, especially on acid tuffaceous rocks, in lowlands but usually 700–1000 m.

**43. *Vatica brevipes*** ASHTON, Gard. Bull. Sing. 31 (1978) 24.

Small to medium-sized tree. Buds, petioles and panicles densely persistently pale brown scabrid puberulent; parts of petals exposed in bud and ovary evenly so, sepals caducously evenly so; parts otherwise glabrous. *Twigs* c. 2 mm  $\varnothing$  apically, red-brown, prominently rugose and ribbed, becoming flaky. *Buds* to 3 by 2 mm, ellipsoid, *Leaves* (4–)5–13 by (1.5–)2.5–5.5 cm, elliptic or obovate, thinly coriaceous; base narrowly cuneate; acumen to 6 mm long, short but slender; nerves 7–10 pairs, ascending, straight at first, arching and forming a  $\pm$  incomplete intramarginal nerve, slender but prominent beneath, elevated above, with a few short secondaries; tertiary nerves distantly reticulate, clearly evident on both surfaces though more so below; *petiole* 5–11 mm long, short, rather stout. *Panicles* to 1.6 cm long, short, very slender, axillary or terminal, hardly branched; *buds* to 3 by 2 mm, ellipsoid; *sepals* narrowly deltoid, lanceolate, subacute; *anthers* broadly oblong, tapering distally to the deltoid appendages; *style* broadly columnar, slightly longer than the ovary, terminating in a prominent rim beneath the deltoid style. *Fruit pedicel* to 6 mm long, slender; 2 longer *calyx lobes* to 5 by 1.4 cm, spatulate, subacute or obtuse; 3 shorter lobes to 12 by 3 mm, lanceolate, acute; *nut* to 8 mm  $\varnothing$ , subglobose, apiculate.

Distr. *Malesia*: Borneo (Sarawak: Ulu Rejang).

Ecol. Local, in Mixed Dipterocarp forest, to 700 m.

**44. *Vatica micrantha*** SLOOT. Bull. Bot. Gard. Btzig III, 17 (1942) 246, f. 33; ASHTON, Man. Dipt. Brun. (1964) 73, f. 10; *ibid.* Suppl. (1968) 33; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 312.

Young twig, panicle, leaf bud, stipule, and petiole densely  $\pm$  persistently pale brown scabrid tomentose, leaf nervation beneath and midrib above sparsely so. *Twig* to 2 mm  $\varnothing$  apically, terete, smooth or slightly striated. *Bud* to 3.5 by 2 mm, ovoid, acute. *Stipule* to 7 by 3 mm, hastate, acute. *Leaves* 4.5–16 by 1.5–6 cm, thinly coriaceous, elliptic-oblong to lanceolate; base obtuse; acumen to 1.5 cm long, narrow; nerves 8–11 pairs, slender, curved, at 55°–70°, raised beneath, the lamina frequently bullate between them; secondary nerves slender, short; midrib slender, prominent beneath,  $\pm$  applanate above; *petiole* 5–10 mm long. *Panicle* to 7.5 cm long, terete, terminal or axillary, singly branched; *flower bud* to 1.3 cm long; *calyx* shortly pubescent; *corolla* cream, suffused with violet towards base outside at first; flowers otherwise typical. *Fruit pedicel* to 2.5 mm long, short; *calyx* sparsely glabrescent, free to the impressed base; 2 longer lobes to 5.8 by 1.5 cm, chartaceous, oblong-spatulate, subacute, base to 3 mm broad, revolute; 3 shorter lobes to 25 by 6 mm, ovate, caudate-acuminate, similar at base. *Nut* to 14 by 8 mm, ellipsoid, obtuse, shortly pale yellow-brown pubescent; style remnant short or usually absent.

Distr. *Malesia*: Borneo.

Ecol. Widespread in Mixed Dipterocarp forest below 600 m, especially on sedimentary rocks.

Vern. *Resak hijau* (Brun.), *r. bulu* (Sabah).

**45. *Vatica flavovirens*** SLOOT. Bull. Bot. Gard. Btzig III, 17 (1942) 252, f. 36; Reinwardtia 2 (1952) 66.

Medium-sized tree. Young twig, petiole and calyx densely evenly  $\pm$  caducous pale ochereous buff pubescent; panicle, ovary, fruit pedicel and part of petals exposed in bud persistently so. *Twig* c. 2 mm  $\varnothing$  apically, terete, rugulose, drying dark brown. *Leaves* 8–21 by 2–7 cm, narrowly elliptic to lanceolate, coriaceous,  $\pm$  lustrous, margin subrevolute; base cuneate or occasionally obtuse; acumen to 1 cm long or short, tapering; nerves 12–14 pairs, arched, slender but  $\pm$  distinctly and equally elevated on both surfaces as also the midrib, short  $\pm$  obscure secondary nerves, and densely reticulate tertiary nerves; *petiole* 13–25 mm long, slender. *Panicle* to 14 cm long, terminal or axillary,  $\pm$  irregularly doubly branched. *Flower buds* to 10 by 3 mm; *sepals* narrowly lanceolate, unequal; *anthers* ellipsoid; appendage very small; style as long as ovary, short, capitate; stigma deltoid; flowers otherwise typical. *Fruit pedicel* to 4 mm long, slender; *calyx lobes* unequal, free to base; 2 longer lobes to 4.5 by 1.7 cm, spatulate, acute, c. 5 mm broad at base; 3 shorter lobes to 20 by 5 mm, lanceolate, subacuminate; *nut* to 7 mm  $\varnothing$ , subglobose.

Distr. *Malesia*: Celebes.

Ecol. Locally common on hill slopes below 400 m.



Vern. *Hulodiri puteh*, *li. motaha*, *kongieh*, *moro lariah* (Tobela), *awalasa*, *bolampao*, *dama dama*, *tom-borusu* (Bug).

**46. *Vatica badiifolia*** ASHTON, Gard. Bull. Sing. 22 (1967) 266, pl. 8; Man. Dipt. Brun. Suppl. (1968) 30, pl. 7 (bark & slash). — *V. bantamensis* (non B. & H. ex MIQ.) ASHTON, Man. Dipt. Brun. (1964) 266, f. 10.

Young twig, panicle, leaf bud, stipule, and petiole  $\pm$  densely evenly shortly caducous fulvous pubescent. *Twig* to 3 mm  $\varnothing$  apically, terete or ribbed, becoming smooth. *Bud* to 1.5 by 1 mm, ovoid, subacute. *Stipule* to 5 by 1.5 mm, hastate, acute. *Leaves* 7.5–15 by 3–6.5 cm, coriaceous,  $\pm$  elliptic; base  $\pm$  cuneate; acumen to 5 mm long, deltoid; nerves 9–12 pairs, curved, prominent, stout, terete beneath, slightly raised above; *petiole* 2–3.5 cm long, thickened in the distal half. *Panicle* to 8 cm long, terminal or axillary, singly or doubly branched. Flower buds to 1.3 cm long; *calyx* densely shortly cream pubescent; flower typical. *Fruit pedicel* to 5 mm long, slender. *Calyx lobes* caducous, pink-brown pubescent, free almost to the pedicel, fused into a flat plate at the base; 2 longer lobes to 8 by 2.5 cm, oblong-spatulate, chartaceous, constricted to 6 mm wide at the base; 3 shorter lobes to 30 by 8 mm, hastate, acute, constricted to 4 mm wide at base. *Nut* to 8 mm long and  $\varnothing$ , globose, shortly evenly fulvous pubescent, crowned by the up to 2 mm long abrupt linear style remnant.

Distr. *Malesia*: Borneo (Rejang valley to Brunei; W. Kalimantan: Kapuas valley).

Ecol. Deep soils on low coastal hills, Mixed Dipterocarp forest.

**47. *Vatica perakensis*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 103, *p.p.*; *emend.* SYM. J. Mal. Br. R. As. Soc. 19, 2 (1941) 152; Mal. For. Rec. 16 (1943) 226; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 132, t. 3, f. 18–19, *p.p.*; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 149, t. 181, *p.p.*; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 86, *p.p.*; Foxw. Mal. For. Rec. 10 (1932) 262, *p.p.*; BURK. Dict. (1935) 2224; ASHTON, Gard. Bull. Sing. 31 (1978) 24. — *Synaptea perakensis* RIDL. Fl. Mal. Pen. 1 (1922) 242, *p.p.* — *V. songa* SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 93, f. 4; HEYNE, Nutt. Pl. ed. 2 (1927) 1131.

Small to medium-sized tree. Twig endings, petiole, panicles, and parts of perianth exposed in bud persistently greyish pink or yellow-brown cinereous, leaf nervation beneath and nut glabrescent. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched, terete, pale brown. *Leaf bud* small, ovoid. *Leaf* 6–14 by 1.8–3.8 cm, lanceolate to oblanceolate; base cuneate, tapering; acumen to 2 cm long, slender, subcaudate; nerves 11–13 pairs, slender but prominent beneath, evident above as also the midrib, ascending; tertiary nerves densely subreticulate, evident on both surfaces; *petiole* 1–2 cm long, slender. *Panicle* to 5 cm long, singly  $\pm$  irregularly branched; flowers typical. *Fruit pedicel* to 6 by 1 mm, long, slender; 2 longer *calyx lobes* to 6 by 1.8 cm, spatulate, obtuse, c. 5 mm broad at the subrevo-

lute base; 3 shorter lobes to 15 by 6 mm, lanceolate, acute; nut to 10 cm  $\varnothing$ , ovoid, apiculate.

Distr. *Malesia*: Malaya (S. Kedah, Perak), Central Sumatra (P. Musala, Tapanuli, Indragiri); one doubtful collection (SAN 41580) from Pulau Kelambu near the N.E. Borneo coast at Tawau.

Ecol. Common in coastal hills and on low ridges to 600 m.

Vern. *Resak puteh*.

**48. *Vatica nitens*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 104; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 131; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 150, t. 182A; BURK. J. Str. Br. R. As. Soc. 81 (1920) 61; Dict. (1935) 2224; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 78; Foxw. Mal. For. Rec. 10 (1932) 254; SYM. Mal. For. Rec. 16 (1943) 223, f. 107, 108; ASHTON, Man. Dipt. Brun. (1964) 74, f. 10; *ibid.* Suppl. (1968) 34, f. 5. — *Synaptea nitens* RIDL. Fl. Mal. Pen. 1 (1922) 241; *ibid.* 5 (1925) 292. — *V. cuspidata* (non RIDL.) BROWNE, For. Trees Sarawak & Brunei (1955) 100.

Young vegetative parts densely powdery fulvous tomentose, fugaceous on leaf, subpersistent only on panicle, leaf bud and stipule. *Twig* to 2 mm  $\varnothing$  apically, becoming smooth, glabrous. *Bud* to 3 by 3.5 mm, ovoid, acute. *Stipule* to 20 by 3.5 mm, narrowly oblong, subacute, caducous. *Leaves* 10–17 by 3.5–5.5 cm, coriaceous, narrowly oblong; base obtuse or cuneate; acumen to 1 cm long; nerves 12–22 pairs, raised beneath, curved, at 45°–70°, with short secondary nerves; midrib obtuse, raised beneath, applanate or slightly raised above; *petiole* 1–2 cm long, slightly geniculate. *Panicle* to 11 cm long, terminal, occasionally axillary, densely persistently fulvous tomentose, terete or angular; singly, rarely doubly, branched; *bracteoles* fugaceous. *Flower bud* to 7 by 3 mm, fusiform; *calyx* densely pubescent on both surfaces, lobes narrowly deltoid, acute; *appendage to connective* short, stout; style very short, not exceeding anthers; flowers otherwise typical. *Fruit pedicel* 3–5 mm long, *calyx* fulvous powdery tomentose, glabrescent, base impressed; 2 longer lobes to 13 by 2 cm, free to base, oblong, slightly recurved, hastate, acute; base to 7 mm broad,  $\pm$  revolute. *Nut* to 3 cm  $\varnothing$ , globose, shortly densely persistently pale fulvous tomentose.

Distr. *Malesia*: Malaya (except seasonal areas, Borneo (Kapuas valley; Sarawak to S.W. Sabah).

Ecol. Scattered on low hills, and ridges to 600 m, in Mixed Dipterocarp forest.

Vern. *Resak daun panjang* (Mal.).

**49. *Vatica cuspidata*** (RIDL.) SYM. Mal. For. 3 (1934) 200; J. Mal. Br. R. As. Soc. 19 (1941) 149; Mal. For. Rec. 16 (1943) 219, f. 107. — *Synaptea cuspidata* RIDL. J. Str. Br. R. As. Soc. 82 (1920) 172; Fl. Mal. Pen. 1 (1922) 242. — *Synaptea maingayi* RIDL. Fl. Mal. Pen. 1 (1922) 240 *p.p.* — *V. maingayi* (non DYER) SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 85, *p.p.*; Foxw. Mal. For. Rec. 10 (1932) 261, *p.p.*

Medium-sized to large tree. Young twigs, petioles



Fig. 47. *Vatica maingayi* DYER. a. Flowering twig, b. fruiting twig, c. fruit, all  $\times 2/3$  (a SF 34959, b-c ANDERSON 9159).

v.Os.



and panicles persistently pale ferruginous scabrid pubescent, ovary and perianth outside densely puberulent, fruit calyx glabrescent. *Twig* c. 2 mm  $\varnothing$  apically, ribbed, pale brown. *Bud* to 3 by 2 mm, ovoid, acute; *stipule* fugaceous. *Leaf* 7–18 by 2.8–6 cm, elliptic to oblong-lanceolate, coriaceous; base broadly cuneate; acumen to 1 cm long, slender, prominent; nerves 10–17 pairs, arched, slender but distinctly elevated beneath, less elevated above as also midrib and the subscalariform tertiary nerves; *petiole* 2–4(–5) cm long, c. 2 mm  $\varnothing$ , slender. *Panicle* to 7 cm long, terminal or axillary, irregularly branched. *Flower bud* to 6 by 2 mm; *appendages* very short, hardly exceeding anthers; *style* columnar, slightly longer than ovary, broadening distally into the prominent long slender conical stigma; flowers otherwise typical. *Fruit pedicel* to 5 by 1 mm, slender, prominent; 2 longer *calyx lobes* to 7 by 1.5 cm, spatulate, obtuse, c. 4 mm wide at base; 3 shorter lobes to 25 by 7 mm, lanceolate, acute; *nut* to 8 by 8 mm, ovoid, apiculate.

Distr. *Malesia*: Malaya.

Ecol. Common, coastal hills and inland ridges.

Vern. *Resak daun runching*.

**50. *Vatica maingayi*** DYER, Fl. Br. Ind. 1 (1874) 302; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 104; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 131; SLOOT, Bull. Jard. Bot. Btzig III, 9 (1927) 85, *p.p. quoad desc.*; FOXW. Mal. For. Rec. 10 (1932) 261, *p.p.*; BURK. Dict. (1935) 2224; SYM. J. Mal. Br. R. As. Soc. 19 (1941) 151; Mal. For. Rec. 16 (1943) 223, f. 107; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 309; ASHTON, Man. Dipt. Brun. Suppl. (1968) 33. — *V. lowii* (non KING emend. SYM.) KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 103, *p.p.*; SLOOT, Bull. Jard. Bot. Btzig III, 9 (1927) 83. — *Synaptea maingayi* RIDL. Fl. Mal. Pen. 1 (1922) 240, *p.p.* — *Synaptea lowii* RIDL. Fl. Mal. Pen. 1 (1922) 241, *p.p.* — *V. macroptera* SLOOT, ex THOR-ENNAAR, Med. Proefst. Boschw. 16 (1926) 120, t. 21; Bull. Jard. Bot. Btzig III, 9 (1927) 83, *nomen in syn. sub V. lowii*. — *V. aperta* SLOOT, Bull. Bot. Gard. Btzig III, III, 17 (1942) 250. — **Fig. 42B–B2, 47.**

Twigs, petioles, buds and stipules outside shortly fulvous flocculent tomentose, patchily caducous except on buds. *Twigs* c. 2 mm  $\varnothing$  apically, smooth. *Bud* to 3 by 3 mm, ovoid, acute, prominent. *Stipules* to 10 by 3 mm, lorate, leaving conspicuous pale horizontal scars. *Leaves* 5.5–12.5 by 1.2–5 cm, elliptic, somewhat chartaceous; base cuneate; acumen to 1 cm long, deltoid; nerves 9–11 pairs, with few short secondary nerves, appanate above, slender but prominent beneath, arched at 35°–50°; midrib prominent on both surfaces; tertiary nerves slender, reticulate; *petiole* 1–2.5 cm long, prominently geniculate, ribbed. *Panicle* to 4 cm long, axillary, short, ribbed, shortly patchily caducous fulvous flocculent tomentose, irregularly singly branched; *bracteoles* c. 2 mm long, linear. *Flower buds* to 1 cm long, fusiform; calyx rufous flocculent tomentose; *corolla* bright red; flowers otherwise typical. *Fruit* shortly fulvous flocculent tomentose, subsistent on nut, patchily cadu-

cous elsewhere. *Pedicel* to 3 mm long; calyx lobes free to within 2 mm of the pedicel; 2 longer *calyx lobes* to 8 by 2.5 cm, lorate to narrowly ovate, obtuse, c. 7 mm wide and somewhat revolute at base; 3 shorter lobes to 2.5 by 1 cm, narrowly ovate, acute, 3 mm wide at base. *Nut* to 7 by 7 mm, globose, shortly mucronate.

Distr. *Malesia*: Malaya, Singapore, Sumatra (Palembang), Borneo (Sarawak W. of Lupar, S.W. Sabah).

Ecol. Locally frequent, on low lying land and hillsides below 500 m.

Vern. *Resak lidi*, *këruing babi*, *jenuong* (Mal.), *resak daun merah* (Sabah).

**51. *Vatica lowii*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 103, *p.p.*; emend. SYM. J. Mal. Br. R. As. Soc. 19 (1941) 153; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 131, *p.p.*; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 150, t. 182B; SYM. Mal. For. Rec. 16 (1943) 222, f. 107. — *V. perakensis* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 103, *p.p.*; FOXW. Mal. For. Rec. 10 (1932) 262, *p.p.* — *Synaptea lowii* RIDL. Fl. Mal. Pen. 1 (1922) 241 *p.p.*

Small to medium-sized tree. *Leaf bud*, petiole and panicle persistently pale rufous scabrid somewhat flocculent puberulent; young twigs and calyx outside caducously so; young leaves fugaceously so; petals on parts exposed in bud and ovary prominently evenly pale rufous puberulent. *Twig* c. 2 mm  $\varnothing$  apically, slender, becoming dark brown, smooth, terete. *Buds* to 2 by 1 mm, small, ovoid. *Leaf* 5–14 by 2–5 cm, elliptic-lanceolate, coriaceous, somewhat lustrous; base broadly cuneate to obtuse; acumen to 1 cm long; nerves 11–14 pairs, slender, arched, distinctly elevated beneath, slightly so above as also the midrib; tertiary nerves densely subreticulate, evident and slightly elevated on both surfaces; *petiole* 6–16 mm long, slender. *Panicle* to 3.5 cm long, terminal or axillary, shortly irregularly branched. *Flower buds* to 5 by 2 mm; *appendages* c.  $\frac{1}{2}$  length of anthers, small, deltoid; *style* shorter than ovary, columnar, expanding to the short conical style; flowers otherwise typical. *Fruit pedicel* to 3 by 0.5 mm, very slender, prominent; 2 longer calyx lobes to 6 by 1.4 cm, spatulate, obtuse, c. 3 mm wide at the sub-revolute base; 3 shorter lobes to 18 by 6 cm, lanceolate, acute; *nut* to 5 mm  $\varnothing$ , subglobose, mucronate.

Distr. *Malesia*: Malaya (Kelantan-Thailand border, Perak).

Ecol. Locally abundant, coastal hills and inland ridges below 750 m.

Vern. *Resak pipit*.

Not yet placed

*Mature fruit of the following species are unknown*

**52. *Vatica elliptica*** Foxw. Philip. J. Sc. 67 (1938) 329.

Twig endings, petioles, panicles, calyx outside, parts of petals exposed in bud and ovary  $\pm$  densely persistently ferruginous scabrous puberulent, elsewhere glabrous. *Twig* c. 1 mm  $\varnothing$  apically, slender, at first rugulose, becoming smooth, pale brown. *Leaves*

4–11 by 13–25 cm, narrowly elliptic, thinly coriaceous; tapering to a narrowly obtuse base and to a 1 cm long acumen; margin  $\pm$  narrowly revolute; nerves 12–14 pairs, arched, slender but prominent beneath, elevated above, with short less prominent secondary nerves; tertiary nerves subreticulate, distinctly elevated on both surfaces but more prominent beneath as also the midrib; *petiole* 4–9 mm long, short. *Panicle* to 5 cm long, slender, terminal or axillary, irregularly doubly branched. *Flower bud* to 5 by 3 mm, lanceolate, small; *sepals* subequal; *anthers* narrowly oblong; *appendages* prominent, deltoid; *style* columnar, expanding distally, slightly longer than ovary; stigma deltoid; flowers otherwise typical. *Mature fruit* unknown; very young fruit with subequal reflexed calyx lobes.

Distr. *Malesia*: Philippines (Zamboanga, Mindanao), twice collected.

**53. *Vatica pentandra*** ASHTON, Gard. Bull. Sing. 31 (1978) 24.

Twigs, petioles and panicles persistently shortly scabrid fulvous pubescent, calyx outside  $\pm$  caducously so, parts of petals exposed in bud and ovary persistently evenly buff puberulent. *Twigs* c. 2 mm  $\varnothing$  apically, ribbed, much branched, ascending. *Leaf buds* minute. *Leaves* 18–45 by 9–20 mm, elliptic, thinly coriaceous, with subrevolute margins, obtuse to broadly cuneate base and  $\pm$  deeply retuse apex; nerves 4–5 pairs, ascending, at c. 45°, slender, hardly elevated on either surface though more so below; *petiole* 4–11 mm long, slender, hardly geniculate. *Panicle* to 4 cm long, slender, singly branched; branchlets bearing to 3 flowers. *Flower buds* to 9 by 3 mm; *stamens* 5, in a single whorl; flowers otherwise typical. Fruit unknown.

Distr. *Malesia*: East Borneo (Central Kutei).

Ecol. Unknown, lowlands.

Note. The only *Vatica* with but 5 stamens; the leaves are among the smallest and most distinctive in the genus also.

**54. *Vatica cauliflora*** ASHTON, Gard. Bull. Sing. 31 (1978) 25.

Twigs, petioles and panicles persistently scabrid fulvous pubescent; midrib beneath caducously so; calyx outside, parts of petals exposed in bud and ovary persistently evenly buff puberulent. *Twigs* c. 3 mm  $\varnothing$  apically, stout, ribbed; *leaf buds* minute. *Leaves* 7–22 by 2.5–8 cm, oblanceolate, coriaceous, with subrevolute margins, obtuse to subcordate base and  $\pm$  prominent caudate acumen; nerves 14–16 pairs, ascending at 50°–60°, prominent beneath, evident but depressed above, as also the many secondaries; tertiaries reticulate, barely elevated though evident on both surfaces; midrib prominent beneath, less so above; *petiole* 10–18 mm long, c. 2 mm  $\varnothing$ , relatively slender. *Panicles* to 6 cm long, solitary, axillary, doubly branched, many-flowered. *Flower buds* to 7 by 2 mm, lanceolate, otherwise typical.

Distr. *Malesia*: Ulu Kapuas, W. Borneo.

Ecol. Locally frequent along river banks.

Note. This species is distinguished by the nerves which are depressed above, by the caudate acumen and slender petiole. Very young fruit indicate a possible affinity with *V. venulosa* BL.

**55. *Vatica glabrata*** ASHTON, *sp. nov.*

*V. mangachapoi* BLCO *similans lamina nervis intrinsecus 9–11 ascenditibus petiolo longissimo partibus glabrescentibus ovarii excepto differt.*

Medium-sized tree, to 20 m tall, 1 m girth. Apical buds and ovary densely ocherous puberulent, young parts sparsely caducously so, otherwise glabrous. *Stipules* to 12 by 8 mm, elliptic, obtuse, not at first caducous, leaving a more or less prominent falcate scar. *Leaves* 6–15 (–22) by (2–)2.5–7 cm, lanceolate, coriaceous,  $\pm$  concave, lustrous, with obtuse base and prominently attenuate to 15 cm long acumen; nerves 9–11 pairs, ascending, slender, elevated on both surfaces but more so below, with  $\pm$  short secondaries; tertiaries reticulate, elevated on both surfaces. *Petiole* 1.8–4 cm long, slender, very long. *Panicles* to 7 cm long, irregular, 1– $\infty$  axillary or terminal. *Flowers* white, as in other species. *Fruit* unknown.

Distr. *Malesia*: Borneo: Sarawak, S 34865, 36852 (holotype in K, in fl.), Dulit range, Ulu Tinjar, Baram; BRUN 2526, 2533, Ulu Medamit, Limbang.

Ecol. Local, scattered in submontane forest at 1200–1500 m on acid soils overlying sandstone immediately below the mossy forest zone.

Notes. I collected this species in April 1958 while on an expedition to the Pagon range. Fallen fruit, apparently from this species, were also collected but were lost in a river accident on the return: they were of the *Sinaptea* type, with two long and three short sepals free to the base. The new collections from Sarawak, and more particularly the type differ in their concave laminae and prominent subamplexicaul subpersistent stipules. The unusually long slender petioles, 9–11 pairs of ascending nerves and glabrous young twigs and inflorescences distinguish the four collections from those of *V. mangachapoi* BLCO which it otherwise resembles and convince me that they represent but a single species.

Doubtful species

**56. *Vatica obtusa*** BURCK, Ann. Jard. Bot. Btzig 6 (1887) 228; MERR. En. Born. (1921) 409; SLOOT. Bull. Jard. Bot. Btzig III, 9 (1927) 126, *nom. illeg., non* (WALL.) STEUD.

The type, TEYSMANN HB 11352, from Karimata, is in flower. It is indistinguishable in this state from *V. umbonata* (HOOK. f.) BURCK and *V. pauciflora* (KORTH.) BL.

Excluded

*Vatica imbricata* SLOOT. Bull. Jard. Bot. Btzig III, 16 (1940) 452, f. 10, is according to KOSTERMANS, Reinwardtia 7 (1969) 426 = *Mesua acuminatissima* (MERR.) KOSTERM. (*Guttiferae*).



## 6. DRYOBALANOPS

GAERTN. *f.* Fruct. 3 (1805) 49; DC. Prod. 16, 2 (1868) 606; DYER, J. Bot. 12 (1874) 98, t. 142; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 242; HEIM, Rech. Dipt. (1892) 81; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 46; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 258; SLOOT, Bull. Jard. Bot. Btzig III, 12 (1932) 1; SYM. Mal. For. Rec. 16 (1943) 191, f. 93 (map); BROWNE, For. Trees Sarawak & Brunei (1955) 111; WYATT-SMITH, Mal. For. 18 (1955) 145; ASHTON, Man. Dipt. Brun. (1964) 48; *ibid.* Suppl. (1968) 20; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 278. — *Pterigium* CORREA, Ann. Mus. Hist. Nat. Paris 8 (1806) 397, *p.p.*, *quoad P. teres* CORREA. — *Baillonodendron* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1890) 867. — **Fig. 48–53.**

Large or very large, occasionally medium-sized, trees; with tall, long, concave, rather thick, narrowly rounded plank buttresses, spreading over the surface apically as large sinuous roots; *crown* very large, hemispherical or dome-shaped, rather diffuse; ‘cauliflower’ shaped with a few large twisted branches ascending from the bole apex, the branchlets numerous, bunched towards the ends. *Bark surface* evenly or persistently shaggily flaked; *twigs* ribbed owing to the decurrent leaf trace, slender. *Stipules* linear, fugaceous. *Leaves* coriaceous, prominently acuminate, with slender dense hardly raised nervation; nerves very many, parallel, straight, rarely branched apically, linked at the margin by a  $\pm$  visible intramarginal nerve; secondary nerves, if present, indistinct; tertiary nerves subreticulate, generally obscure; midrib sunken above, prominent beneath; *petiole* distinctly channelled above, slender, not geniculate. *Inflorescences* paniculate, lax, diffuse, few flowered; *bracteoles* minute, fugaceous. *Flower buds* narrowly ovoid, obtuse. *Calyx lobes* equal, imbricate, glabrous, united at base into a  $\pm$  cuneate tube tapering into the pedicel. *Petals* broadly elliptic, subacute, glabrous, hardly contorted in bud, united at base and falling in a rosette, white. *Stamens* *c.* 30, glabrous, subequal, the innermost slightly longer than the outermost, epipetalous, yellow; filaments broad and compressed, connate at base, tapering in the distal half and filiform below the anther; anthers long, linear, latrorse; pollen sacs subequal, the outer somewhat larger than the inner; appendage to connective small, stout, hardly projecting above the anthers. *Ovary*  $\pm$  ovoid, glabrous, without distinct stylopodium; style *c.* 3 times length of ovary, glabrous; stigma minute. *Fruit calyx* with basal cup partially enclosing, but free from, base of nut; 5 lobes subequal, subvalvate, short and acute or long spatulate, obtuse,  $\pm$  rotate. *Nut* large, glabrous, with short apiculate style remnant. Pericarp splitting at *germination* into 3 valves; cotyledons reniform, epigeal, on long slender hypocotyl; first 2 pairs of leaves opposite, with a very short intermediate internode.

Distr. *Malesia*: 7 spp. in Malaya, Central Sumatra, Borneo and intervening islands.

Fossil wood records from S. India, Cambodia, S. Sumatra, W. Java and Amboyna in the Moluccas (SCHWEITZER, Palaeontographica 105B, 1959, 1–66). Fig. 49.

Ecol. Semigregarious or gregarious emergent canopy trees of lowland dipterocarp, Heath and Mixed Peat Swamp forests to 800 m; on account of their size playing an important structural role in the forests where they occur.

Uses. The timber is an important moderately heavy and durable construction timber. *D. aromatica* was once a major source of camphor, obtained as crystals in splits within the bole by felling.



Fig. 48. *Dryobalanops aromatica* GAERTN. f. a. Sterile twig, b. flowering twig, c. fruit, d. nut, all  $\times \frac{1}{2}$  (a, c-d SAN 15148, b KEP 72435).

#### KEY TO THE SPECIES

1. Fruit calyx lobes shorter than nut . . . . . 1. *D. oblongifolia*
1. Fruit calyx lobes longer than nut, aliform.
  2. Leaves usually longer than 14 cm; nerves distinctly unequal, prominent beneath, depressed above . . . . . 2. *D. keithii*
  2. Leaves shorter than 12 cm; nerves hardly raised beneath, subequal, not depressed above.
    3. Fruit calyx lobes 10–12 mm broad. Calyx fused into a to 15 mm  $\varnothing$ , over 5 mm deep, cup at base.
      4. Leaf lanceolate, revolute at base . . . . . 3. *D. lanceolata*
      4. Leaf broadly ovate, not revolute at base . . . . . 4. *D. aromatica*
    3. Fruit calyx lobes to 8 mm broad, narrow. Calyx fused into a cup at base not broader than 8 mm, not deeper than 3 mm.
      5. Leaf 5–8 by 1.7–3 cm, glabrous . . . . . 5. *D. beccarii*
      5. Leaf 6–11 by 2–4 cm, more or less tomentose beneath.
        6. Tomentum persistent, even, dark gold . . . . . 6. *D. fusca*
        6. Tomentum  $\pm$  caducous, flocculent, rufous . . . . . 7. *D. rappa*





Fig. 49. Density map of *Dryobalanops* GAERTN. f. in Malasia; number of endemics above the hyphen, number of non-endemics below it.

1. *Dryobalanops oblongifolia* DYER, J. Bot. 12 (1874) 100, t. 142, f. 8–12; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 224; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 51; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 259; BECC. Nelle For. Born. (1902) 550, 572; MERR. En. Born. (1921) 401; BURK. J. Str. Br. R. As. Soc. 86 (1922) 291; DEN BERGER & ENDERT, Med. Proefst. Boschw. 11 (1925) 104; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 255; THORENAAR, Med. Proefst. Boschw. 16 (1926) 110; FOXW. J. Mal. Br. R. As. Soc. 5 (1927) 340; Mal. For. Rec. 1 (1921) 76; *ibid.* 3 (1927) 49; *ibid.* 8 (1930) 17; *ibid.* 10 (1932) 110; HEYNE, Nutt. Pl. ed. 2 (1927) 1105; SLOOT, Bull. Jard. Bot. Btzig III, 12 (1932) 22; BURK. Dict. (1935) 867; CORNER, Ways. Trees (1940) 212; SYM. Mal. For. Rec. 16 (1943) 196, f. 94B, 95, 98; WYATT-SMITH, Mal. For. 18 (1955) 153, p.p.; BROWNE, For. Trees Sarawak & Brunei (1955) 116; ASHTON, Man. Dipt. Born. Suppl. (1968) 23, f. 4; Gard. Bull. Sing. 31 (1978) 25.

a. *ssp. oblongifolia*. — *Baillonodendron malayanum* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 867; Rech. Dipt. (1892) 38. — *D. abnormis* SLOOT, Bull. Jard. Bot. Btzig III, 16 (1940) 449, f. 8; cf. ASHTON, Gard. Bull. Sing. 22 (1967) 262, 347 (photogr. fr.).

Young twigs caducously shortly evenly densely pale fulvous pubescent; vegetative parts otherwise glabrous. Twig c. 2 mm  $\varnothing$  at apex, terete, smooth, lustrous. Bud to 2 by 1 mm, small, conical, acute. Stipule to 3 by 1 mm, linear, fugaceous. Leaf 6–20 by 4.5–5(–6.5) cm, narrowly oblong, frequently undulate, base broadly cuneate to obtuse, apex cuspidate with 1.5 cm long slender acumen; nervation evident but not prominent beneath, obscure above; midrib depressed above, prominent beneath. Petiole 5–14 mm. Panicle to 14 cm long, terminal or axillary, angular or terete, densely shortly evenly rufous pubes-

cent; singly branched, branchlets to 3 cm long, bearing to 6 distichous flowers; bracteoles minute, fugaceous. Flower buds to 8 by 5 mm, ovoid, glabrous. Sepals subequal, ovate, acute, glabrous. Petals white, oblong, glabrous. Stamens c. 40, unequal, reaching to below the style apex; filaments connate at base, broadly lorate, tapering below the anther insertion, c.  $\frac{1}{2}$  length of anther; anther linear; appendage to connective  $\pm$  erect, exceeding anther apex. Ovary ovoid, glabrous; style 2–3 times as long as ovary, filiform, glabrous. Fruit entirely glabrous. Pedicel short, merging with calyx. Calyx lobes to 5 by 7 mm, deltoid, acute, incrassate, frequently reflexed, bordering a to 1.5 cm deep, to 1.5 cm  $\varnothing$  massive incrassate cup. Nut to 3.5 by 2.7 cm, ellipsoid to obovoid, obtuse to mucronate, prominently lenticellate.

Distr. *Malasia*: Borneo (Kapas hinterland, Sarawak W. of the Kemena, W. Kutei).

Ecol. Local on hillsides below 600 m.

Vern. *Empedu* (Sar.), *kēlansau* (Iban).

b. *ssp. occidentalis* ASHTON, Gard. Bull. Sing. 31 (1978) 26. — *D. beccariana* RIDL. Fl. Mal. Pen. 1 (1922) 211. — *D. ovalifolia* I. H. BURKILL, Illustr. Guide Bot. Gard. Sing. (1927) 22, *nomen*.

Differing as follows: Leaf 6–11 by 2–4.5 cm; fruit calyx tube to 8 mm deep, funnel-shaped, with  $\pm$  obscurely 5-lobed undulate margin; nut broadly ellipsoid, striated but otherwise smooth.

Distr. *Malasia*: Malaya (E. coast, rare from Perak northwards in W.); E. Sumatra (Bengkalis, Riouw, Djambi, Palembang).

Ecol. By streams and in fresh water swamps, locally abundant; occasionally on hillsides.

Vern. *Kēladan*, *kapur paya*, *k. kuras* (Mal.), *k. guras*, *pētanang* (Sum.).

2. *Dryobalanops keithii* SYM. Gard. Bull. S. S. 10 (1939) 379, pl. 27; SLOOT, Bull. Jard. Bot. Btzig III, 16 (1940) 449; Reinwardtia 5 (1961) 475, f. 6; WYATT-SMITH, Mal. For. 18 (1955) 152; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 283, f. 3 d.

Medium-sized tree. Outside of calyx and panicle fugaceous puberulent, parts otherwise glabrous. Twig c. 2 mm  $\varnothing$  apically, ribbed at first, verrucose lenticellate, becoming smooth. Leaves 14–33 by 5–10 cm, lorate to narrowly lanceolate or oblanceolate, coriaceous; margin narrowly subrevolute; base obtuse or cordate; acumen to 1 cm long (longer in young trees), slender, prominent; nerves many but relatively distant, distinct and prominent, beneath, obscure but distinctly narrowly depressed above as also the midrib, arched just within the margin and then uniting with a  $\pm$  straight intramarginal nerve; with shorter less distinct parallel secondary nerves and  $\pm$  obscure reticulate tertiary nerves; petiole 7–12 mm long, short, stout. Panicles to 14 cm long, singly or doubly (if terminal) branched, terminal or subterminal axillary, lax; branchlets to 3.5 cm long, bearing to 4 flowers; bracts and bracteoles to 2 by 2 mm, suborbicular-deltoid, not at first caducous. Flower bud to 10 by 4 mm,

ellipsoid, acute; *sepals* narrowly deltoid, subacute; *petals* ovate, acute, glabrous; *stamens* subequal, slightly shorter than the style; filaments compressed, tapering distally, united at base, c.  $\frac{1}{2}$  length of the linear tapering anthers; appendages acicular, short but distinctly exceeding anther apex; ovary narrowly ovoid, puberulent; *style* filiform, glabrous, c.  $2\frac{1}{2}$  times length of ovary. *Fruit pedicel* to 4 by 2 mm; *calyx lobes* to 4 by 2 cm, broadly spatulate, obtuse, c. 8 mm broad above the to 6 by 10 mm basal cup; *nut* to 16 by 15 mm, depressed ovoid, apiculate.

Distr. *Malesia*: N.E. Borneo (Sandakan bay to Tawau and Tidung).

Ecol. Undulating land and hills to 250 m, never far from water and often on banks of streams; locally common.

Vern. *Kapur gumpait* (Kadazan, Kinabatangan), *k. daun bĕsar*.

**3. *Dryobalanops lanceolata*** BURCK, Ann. Jard. Bot. Btzig 6 (1887) 244, t. 29, f. 6; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 244; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 51, t. 1, f. 1-6; BOERL. Cat. Hort. Bog. 2 (1901) 100; MERR. En. Born. (1921) 401; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 238; HEYNE, Nutt. Pl. ed. 2 (1927) 1106; SLOOT, Bull. Jard. Bot. Btzig III, 12 (1932) 28, f. 3; WYATT-SMITH, Mal. For. 18 (1955) 115; BROWNE, For. Trees Sarawak & Brunei (1955) 116; ASHTON, Man. Dipt. Brun. (1964) 52; *ibid.* Suppl. (1968) 22; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 285, pl. 21 (stem), f. 47, pl. 29 (habit). — *D. oblongifolia* DYER, J. Bot. 12 (1874) 100, p.p. — *D. kayanensis* BECC. Nelle For. Born. (1902) 551; MERR. En. Born. (1921) 401; HEYNE, Nutt. Pl. ed. 2 (1927) 1104.

Leaf bud and stipule sometimes shortly fugaceous tomentose, otherwise entirely glabrous. *Twigs* 1.5-2 mm  $\varnothing$  apically, slender, dotted with minute pale brown lenticels, smooth but for the prominent ribs above the lateral bundles of the petiole. *Bud* c. 4 by 1 mm, narrowly lanceolate. *Stipule* to 12 by 1 mm, narrowly lanceolate. *Leaves* 7-10 by 2-3.5 cm, lanceolate, thinly coriaceous, base cuneate, with revolute margin, acuminate to 1 cm long, slender; margin frequently undulate; *petiole* c. 1 cm long, slender. *Panicle* to 6 cm long; terminal or axillary, ribbed and angular on drying, glabrous; simple or singly branched. *Flower bud* to 12 by 5 mm, fusiform, obtuse. *Calyx* glabrous; lobes subequal, lanceolate, obtuse. *Corolla* white; petals lanceolate, acute, glabrescent. *Stamens* c. 30, subequal, shorter than the style; filaments compressed, slender, tapering, united at base; anthers linear; appendage to connective short, hardly exceeding anther apex. *Ovary* small, ovoid, glabrous; *style* filiform, c. 3 times length of ovary, glabrous. *Fruit calyx* with to 2 cm  $\varnothing$ , to 5 mm deep, shallow cup at base, impressed at the pedicel; with a shallow tubercle at the base of each calyx lobe; lobes to 9 by 2 cm, spatulate, equal, obtuse, tapering gradually to a 3-5 mm broad base. *Nut* to 2 cm long and  $\varnothing$ , ovoid to globose, glabrous, subacute.

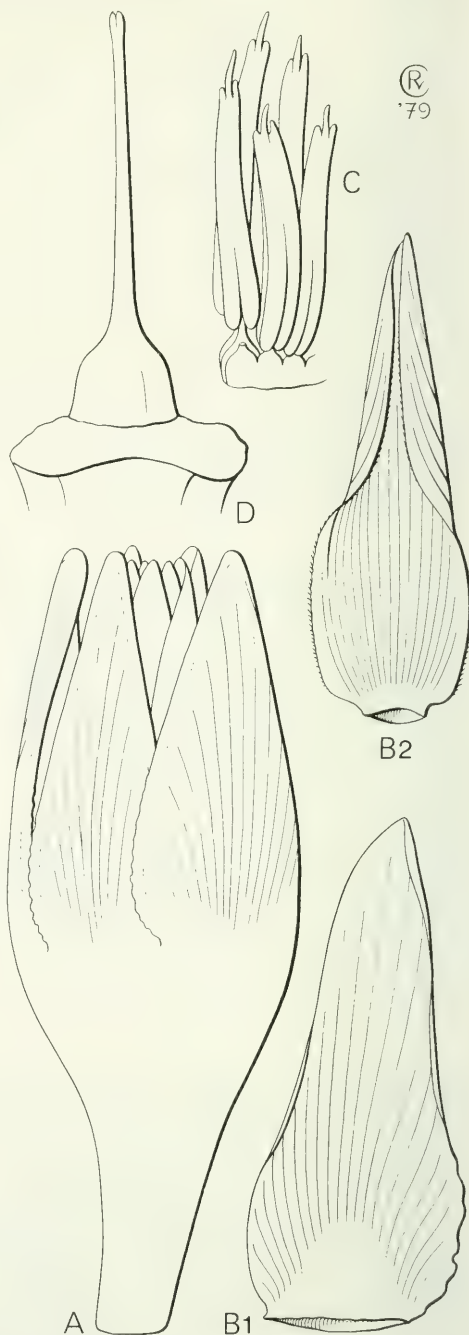


Fig. 50. *Dryobalanops aromatica* GAERTN. f. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C. stamens from outside, D. pistil, all  $\times 10$  (Cult. Hort. Bog. XI-B-XVII-213).



Distr. *Malesia*: Borneo (N.E. of the Lupar to Sabah, and S.E. to W. Kutei and Sangkulirang).

Ecol. Widespread on fertile clay-rich soils, abundant on undulating land on basic volcanics and calcareous shale to 700 m.

Uses. The most valuable kapur source in N.E. Borneo; the timber floats.

Vern. *Paji*, *kapur paji* (M., Iban), *k. daram*, *k. bukit* (Brun.), *sesuan* (Murut), *ngeri* (Bassap), *adu* (Kwijau), *jalam* (Dus.).

**4. *Dryobalanops aromatica*** GAERTN. *f. Fruct.* 3 (1805) 49, t. 186, f. 2; BL. *Fl. Jav.* 2 (1828) Dipt. 6 in not.; Mus. Bot. Lugd.-Bat. 2 (1852) 38; WALP. Ann. 4 (1857) 336; HOOK. *f. Trans. Linn. Soc.* 23 (1860) 160; BAILLON, *Hist. Pl.* 4 (1872) 202, f. 211–214; DYER, *J. Bot.* 12 (1874) 100, t. 142, f. 1–5; BURCK, *Ann. Jard. Bot. Btzig* 6 (1887) 243; LAKE & KELSALL, *J. Str. Br. R. As. Soc.* 26 (1894) 35; Agr. Bull. Str. & F. M. S. 1 (1901) 61; Fl. Mal. Pen. 1 (1922) 210; BRANDIS, *J. Linn. Soc. Bot.* 31 (1895) 50; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 259, fig; BOERL. Cat. Hort. Bog. 2 (1901) 100; HEYNE, *Nutt. Pl. ed.* 1, 3 (1917) 276; BURCK, *J. Str. Br. R. As. Soc.* 81 (1920) 56, fig.; *ibid.* 86 (1922) 291; MERR. *En. Born.* (1921) 401; FOXW. *Mal. For. Rec.* 1 (1921) 74; *ibid.* 2 (1921) 68; *ibid.* 8 (1927) 45; *ibid.* 10 (1932) 105; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 255; HENDERSON, *Gard. Bull. S. S.* 4 (1928) 226; WATSON, *Mal. For. Rec.* 5 (1928) 59, 60, 184; EDWARDS, *Mal. For. Rec.* 9 (1930) 129; SLOOT. *Bull. Jard. Bot. Btzig* III, 12 (1932) 7, f. 1; BURCK. *Dict.* (1935) 862; CORNER, *Ways. Trees* (1940) 211; SYM. *Mal. For. Rec.* 16 (1943) 194, f. 94A, 95, 96 (map), 97; WYATT-SMITH, *Mal. For.* 18 (1955) 148; BROWNE, *For. Trees Sarawak & Brunei* (1955) 114; BACKER & BAKH. *f. Fl. Java* 1 (1963) 330; ASHTON, *Gard. Bull. Sing.* 20 (1963) 241; Man. Dipt. Brun. (1964) 49, f. 8, pl. 15 (habit), pl. 18 (stem); *ibid.* Suppl. (1968) 22; MEIJER & WOOD, *Sabah For. Rec.* 5 (1964) 278, f. 45. — *Arbor camphorifera* RUMPH. *Herb. Amb. cap.* 82 (1755) 67. — *Pterigium teres* CORREA, *Ann. Mus. Hist. Nat. Paris* 10 (1807) 159, t. 8, f. 1. — *D. camphora* COLEBR. *As. Res.* 12 (1816) 535, t. 8; JACK in Hook. *Comp. Bot. Mag.* 1 (1835) 264; Calc. *J. Nat. Hist.* 5 (1843) 117; KORTH. *Kruidk.* (1841) 68; WALP. *Rep.* 5 (1845) 125; LINDL. *Veg. Kingd.* (1846) 393; DE VRIESE in *Miq. Pl. Jungh.* (1851) 80; Ned. *Kruidk. Arch.* 3 (1851) 1–89, *cam tab.*; transl. in Hook. *J. Bot. Kew Misc.* 4 (1852) 33, 68; HOOK. *f. ibid.* 4 (1852) 200; DE VRIESE, *Tuinb. Fl.* (1856) 86; Mém. sur le Camphrier (1856) t. 1–2; OUDEMANS, *Ann. Sc. Nat.* IV, 5 (1856) 90, t. 4; HAYNE, *Arzneigew.* 12 (1856) 17, *cam tab.*; MIQ. *Fl. Ind. Bat.* 1, 2 (1856) 499; *Ann. Mus. Bot. Lugd.-Bat.* 3 (1867) 85; DC. *Prod.* 16, 2 (1868) 606; WALP. *Ann.* 7 (1868) 377; DEN BERGER & ENDERT, *Med. Proefst. Boschw.* 11 (1925) 104; HEYNE, *Nutt. Pl. ed.* 2 (1927) 1099. — *Shorea camphorifera* ROXB. *Fl. Ind. ed.* Carey 2 (1832) 616; *ibid.* ed. 4 (1873) 440; DC. *Prod.* 16, 2 (1868) 632. — *Dipterocarpus dryobalanops* STEUD. *Nomencl. Bot. ed.* 2, 1 (1840) 518; DC. *Prod.* 16, 2 (1868) 614; WALP. *Rep.* 5 (1845) 124. — *Diptero-*

*carpus teres* STEUD. *Nomencl. Bot. ed.* 2, 1 (1840) 518; DC. *Prod.* 16, 2 (1868) 614. — *D. junghuhnii* BECC. *Nelle For. Born.* (1902) 554. — *D. vriesii* BECC. *Nelle For. Born.* (1902) 554. — Fig. 48, 50–52.

Young twig, raceme, stipule, petiole and leaf beneath at first sparsely minutely lepidote, appearing yellowish, becoming glabrous. *Twig* c. 1 mm  $\varnothing$  apically, slender, smooth. *Bud* 2–5 by 1–1.5 mm, small, narrowly lanceolate, often compressed. *Stipule* 5–8 mm long, small, linear, fugaceous. *Leaves* 4–6 by 2–4 cm,  $\pm$  broadly ovate, coriaceous, sometimes (excluding acumen) broader than long, base cuneate or broadly obtuse, acuminate to 1.5 cm long, prominent; nervation indistinct; midrib depressed above, prominent beneath; *petiole* 0.5–1 cm long, slender. *Panicle* to 7 cm long, terminal or axillary, ribbed and angular on drying, singly or doubly branched. *Flower bud* to 9 by 4 mm, fusiform. *Calyx* glabrous, lobes subequal, lanceolate, obtuse. *Corolla* white, petals glabrous,  $\pm$  oblong, acute. *Stamens* c. 30, subequal, shorter than the style; filaments slender, tapering, united at base; anthers linear; appendage to connective short, linear, somewhat exceeding anther apex. *Ovary* small, ovoid, glabrous; style filiform, c. 2 times length of ovary, glabrous. *Fruit calyx* base 6–8 mm deep, 8–15 mm  $\varnothing$ , cup-shaped,  $\pm$  constricted at the rim; lobes equal, 4–6 by 0.8–2 cm, spatulate, obtuse, to 3–5 mm broad at the base, entirely glabrous. *Nut* to 3 by 1.5 cm, ovoid, glabrous, constricted at the apex of the calyx cup, acute, with a short style remnant.

Distr. *Malesia*: Malaya (down E. coast from Trengganu southwards, rare in Selangor and Negri Sembilan), N.W. Sumatra (Angkola, Sibolga, Kelantan and Upper Singkil), E. Sumatra (Bengkalis, Siak), Musala, Lingga, Singkep, Borneo (N.E. of the Rejang to S.W. Sabah).

Ecol. Locally dominant, gregarious on dry sandy or gravelly soils over sandstone and granite, on subcoastal hills or (rarely) inland quartzite dikes to 400 m.

Uses. The most important source of camphor, and kapur timber, in the genus.

Vern. *Kapur* (Mal.), *k. barus* (Sum.), *k. bukit*, *k. përingii*, *k. anggi* (Brun.), *këladan* (Iban), *tëljain* (Belait).

**5. *Dryobalanops beccarii*** DYER, *J. Bot.* 12 (1874) 100, t. 142, f. 6–7; BURCK, *Ann. Jard. Bot. Btzig* 6 (1887) 243; BRANDIS, *J. Linn. Soc. Bot.* 31 (1895) 50; BECC. *Nelle For. Born.* (1902) 572; MERR. *En. Born.* (1921) 401; SLOOT. *Bull. Jard. Bot. Btzig* III, 12 (1932) 36; WYATT-SMITH, *Mal. For.* 17 (1955) 149; BROWNE, *For. Trees Sarawak & Brunei* (1955) 115; ASHTON, *Gard. Bull. Sing.* 20 (1963) 242; Man. Dipt. Brun. (1964) 51, f. 8, pl. 16 (stem); *ibid.* Suppl. (1968) 22; MEIJER & WOOD, *Sabah For. Rec.* 5 (1964) 280, pl. 28 (stem), f. 46. — *D. beccariana* RIDL. *Fl. Mal. Pen.* 1 (1922) 211, *p.p.* — *D. oiocarpa* SLOOT. *ex* HEYNE, in Den Berger & Endert, *Med. Proefst. Boschw.* 11 (1925) 107; *Nutt. Pl. ed.* 2 (1927) 1106; ENDERT, *M.-O. Born. Exp.* (1927) 239; VAN DER LAAN, HARING & LIT,



Fig. 51. Crown of *Dryobalanops aromatica* GAERTN. f. Brunei (Photogr. ASHTON).



Bijdr. boom. Z.O. Borneo (1928) 19, *nomen*. — *D. oocarpa* SLOOT. Bull. Jard. Bot. Btzg III, 12 (1932) 33, f. 4; WYATT-SMITH, Mal. For. 17 (1955) 149.

Young parts sometimes fugaceous puberulent, all parts otherwise entirely glabrous. *Twig* to 1 mm  $\varnothing$  apically, slender, smooth. *Bud* 3–4 by 2 mm, narrowly lanceolate, compressed. *Stipule* 5–8 mm long, linear, fugaceous. *Leaves* 5–8 by 1–3 cm, ovate to lanceolate, comparatively thin, base cuneate, acuminate to 17 mm long, narrow, margin frequently undulate; *petiole* 0.7–1 cm long, very slender. *Panicle* to 10 cm long, terminal or axillary, terete, wrinkled on drying, irregularly doubly branched; *bracteoles* and *bracts* small, linear, fugaceous. *Flower bud* to 10 by 3.5 mm, fusiform, acute. *Sepals* glabrous, equal, narrowly deltoid, subacute. *Corolla* white; petals large, broadly elliptic, obtuse, glabrous. *Stamens* c. 30, subequal, almost  $\frac{2}{3}$  length of style; filaments united in a tube around the base of the ovary, the tube almost half as long as the anthers; anther narrowly oblong, the cells tapering, acute; appendage to connective short, erect, slightly exceeding anther. *Ovary* ovoid, glabrous; style 2–3 times as long as ovary, filiform, glabrous. *Fruit calyx* glabrous; base with to 8 mm  $\varnothing$ , shallow or to 5 mm deep cup, unstricted at the rim, tapering gradually and cuneate at the pedicel; lobes equal, to 6.5 by 0.8 cm, glabrous, oblong-spatulate, narrow, subacute, to 2 mm broad at the base, very thin and opaque between the reticulations of the nerves. *Nut* to 1.4 cm long and  $\varnothing$ , ovoid to globose, glabrous, with acute style remnant, resting on the considerably narrower calyx cup and pushing the lobes out to a wide angle.

Distr. *Malasia*: Borneo (excepting S. and S.W.).

Ecol. Locally abundant on leached sandy soils on coastal hills and inland ridges below 700 m.

Vern. *Kapur*, *k. merah*, *k. ranggi* (Mal.), *kēladan* (Iban).

Note. Collections from S.E. Borneo tend to have longer narrower leaves, often less coriaceous, than those from elsewhere; the species generally occurs on deeper, more fertile soils there. Nevertheless there is no consistent way in which these plants may be distinguished in field or herbarium.

**6. *Dryobalanops fusca*** SLOOT. Bull. Jard. Bot. Btzg III, 12 (1932) 39, f. 5; WYATT-SMITH, Mal. For. 17 (1955) 149; ASHTON, Man. Dipt. Brun. Suppl. (1968) 22, f. 4.

Leaf undersurface shortly densely evenly persistently golden tomentose; midrib beneath, petiole, leaf bud and stipule outside (subglabrous within) more darkly so. *Twig* 1–2 mm  $\varnothing$  at the apex, slender, much branched. *Bud* to 4 by 2 mm, lanceolate, acute. *Stipule* to 3 by 1 mm, linear, fugaceous. *Leaves* 5–10 by 2–4 cm, broadly lanceolate, coriaceous, base obtuse or broadly cuneate; acuminate to 1.5 cm long, slender, tapering, caudate; nerves obscured by tomentum; midrib depressed above, prominent beneath; *petiole* 5–10 mm long, short, drying pale rufous tomentose. *Panicle* to 5 cm long, terminal or axillary, terete,



Fig. 52. Trunk-base of *Dryobalanops aromatica* GAERTN. f. *Brunei* (Photogr. ASHTON).

densely shortly evenly pale rufous tomentose; singly branched, branchlets to 2 cm long, bearing to 3 flowers. *Flower bud* to 12 by 3 mm, lanceolate, glabrous. *Sepals* equal, narrowly lorate-deltoid, obtuse, glabrous. *Petals* lanceolate, glabrous. *Stamens* c. 30, subequal, reaching to below style apex; filaments connate at base, tapering, c.  $\frac{2}{3}$  length of anthers; anthers narrowly oblong, tapering; appendage to connective erect, extending somewhat above anther apex. *Ovary* ovoid, glabrous; style 3–4 times length of ovary, filiform, glabrous. *Fruit* entirely glabrous. *Pedicel* to 6 mm long, prominent. *Calyx lobes* to 6 by 1.3 cm, spatulate, obtuse, c. 4 mm wide above the to 3 mm deep, to 7 mm  $\varnothing$ , shallow thickened basal cup. *Nut* to 2 by 1.3 cm, ellipsoid-ovoid, apiculate.

Distr. *Malasia*: W. Borneo (N. of the Kapuas and W. of the Lupar).

Ecol. Locally dominant on podsols, low ridges and especially raised beaches, in Heath forest.

Vern. *Empedu*, *kapur ĕmpedu* (Mal.).

**7. *Dryobalanops rappa*** BECC. Nelle For. Born. (1920) 572; MERR. En. Born. (1912) 401; SLOOT. Bull. Jard. Bot. Btzg III, 12 (1932) 41; WYATT-SMITH, Mal. For.



Fig. 53. Trunk and crown of *Dryobalanops rappa* BECC., kapur paya. Note shaggy bark. Sarawak (Photogr. SMYTHIES).

18 (1955) 155; BROWNE, For. Trees Sarawak & Brunei (1955) 116; ANDERSON, Gard. Bull. Sing. 20 (1963) 157; ASHTON, Gard. Bull. Sing. 20 (1963) 242; Man. Dipt. Brun. (1964) 53, f. 8, pl. 19 (stem); *ibid.* Suppl. (1968) 23; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 289, f. 48; ASHTON, Gard. Bull. Sing. 31 (1978)

25. — *D. oblongifolia* (non DYER) WYATT-SMITH, Mal. For. 18 (1955) 155. — **Fig. 53.**

Young twig, raceme, stipule and bud, petiole, midrib and leaf beneath densely powdery caducous or persistent rufous tomentose. Twigs slender, becoming smooth but for minute, warty lenticels. Bud 3–6 by 2–3



mm, ovoid, subacute, slightly compressed. *Stipule* 5–8 mm long, linear. *Leaves* 6–11 by 2.5–4 cm, ovate-lanceolate, coriaceous, base obtuse; acuminate to 1 cm long, narrow; midrib prominent, grooved, beneath; *petiole* 6–10 mm long, stout. *Panicle* to 8 cm long, terminal or axillary, ribbed apically on drying, otherwise terete; regularly alternately doubly branched, branchlets bearing up to 4 flowers; *bracteoles* linear, fugaceous. *Flower bud* to 10 by 5 mm, ellipsoid, acute. *Petals* cream, lanceolate, glabrous. *Sepals* equal, narrowly deltoid, obtuse, glabrous. *Stamens* c. 30, subequal, reaching to below style apex; filaments united in a tube round the ovary, tapering apically to the anthers, c.  $\frac{2}{3}$  length of anthers; anthers narrowly oblong, tapering; appendage to connective erect, extending somewhat above anther apex. *Ovary* ovoid, glabrous; style twice as long as ovary, filiform, tapering, glabrous. Base of *fruit calyx* 5–8 mm  $\varnothing$ , 3 mm deep, shallowly cupped; lobes to 5 by 0.6 cm, linear to spatulate, subacute,

2.5–3.5 mm broad at the base. *Nut* to 10 by 6 mm, ovoid, glabrous, crowned by a c. 6 mm long slender persistent style remnant.

Distr. *Malesia*: Borneo (Lower Kapuas, Sarawak, Brunei, W. Sabah).

Ecol. Common, locally dominant and gregarious, in Mixed Peat Swamp forest overlying sand terraces, and on podsols below 200 m.

Uses. Considered of inferior quality, darker, harder and more liable to splitting than other species.

Vern. *Kapur paya* (Mal.), *k. rappa* (Sar.), *lu'an* (Dusan), *lesuan* (Murut), *kajatan* (West Borneo).

Note. SFN 32194, a flowering collection from swamps in S.E. Johore, differs from *D. oblongifolia* DYER in possessing more coriaceous leaf and rufous flocculent pubescent innovations and inflorescence, in this resembling this species which is otherwise unknown outside Borneo. Fruit are required to confirm this record.

### 7. PARASHOREA

KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 65; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 221; HEIM, Rech. Dipt. (1892) 54; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 103; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 370; FOXW. Philip. J. Sc. 67 (1938) 316; SYM. Mal. For. Rec. 16 (1943) 97, f. 58 (map), 59–62; ASHTON, Man. Dipt. Brun. (1964) 82; *ibid.* Suppl. (1968) 38; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 190; WANG HSIE, Acta Phytotax. Sin. 15, 2 (1977) 10, 22, fig.; ASHTON, Gard. Bull. Sing. 31 (1978) 26; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 54. — **Fig. 54–59.**

Large trees with large, rounded, slightly concave, hardly branched plank buttresses. *Crown* dense, becoming dome-shaped or hemispherical, even, the branchlets usually crowded towards the ends but not 'cauliflower' shaped; main branches several to many, radiating from the bole apex (except in *P. macrophylla*). *Bark surface* distinctly mauve-grey to purplish, with narrow shallow fissures, broad smooth or flaking flat ridges, and numerous conspicuous large pale corky lenticels. *Stipules* linear to hastate, fugaceous. *Leaves* broadly oblong-ovate, shortly acuminate; nerves scalariform, with subpersistent plicate folding; no intermediate nerves; young leaves white beneath. *Inflorescence* racemose (except *P. macrophylla*). *Flower* and *fruit* as in *Shorea*, but *sepals* in bud  $\pm$  equal, very narrowly imbricate. *Petals* falling separately. *Stamens* 15, much longer than ovary in bud; filaments short, dilated and compressed at base, tapering abruptly and filiform below anthers; anthers narrowly oblong, with 4 pollen sacs, the inner 2 shorter than outer 2; appendage to connective hardly exceeding anther apex, not reflexed, stout. *Ovary* small,  $\pm$  ovoid, shortly pubescent, with or without a slender stylopodium; style as long as or longer than ovary, filiform, glabrous. *Fruit pedicel* short. *Fruit calyx lobes* either  $\pm$  spatulate, slender, thickened and saccate at the valvate base, frequently subequal, 3 somewhat larger than the other 2, or shorter than nut, equal; pushed apart by the ripening nut. *Nut* large, globose, pubescent, verrucose-lenticellate; style remnant short, indistinct. *Germination* as in *Shorea*, but with seedling leaves at first linear, quite unlike the peltate sapling leaves.

Distr. About 14 *spp.*: southern Burma, Thailand, Indochina and S. China (Yunnan, Kwangsi); in *Malesia*: 10 *spp.*, in Malaya, Sumatra, Borneo, the Philippines and intervening islands. Fig. 55.

Ecol. Local, sometimes abundant, in lowland Mixed and Semi-evergreen Dipterocarp forests, and occasionally hills to 1400 m.

Uses. An important pale coloured light hardwood exported from the Philippines and N.W. Borneo.

#### KEY TO THE SPECIES

1. Fruit sepals shorter than nut, linear-lanceolate, subequal.
2. Leaves glabrescent, silvery stellate puberulent beneath; nerves to 9 pairs (saplings excluded) **1. *P. aptera***
2. Leaves not as above, generally pubescent at least on nervation; nerves at least 10 pairs.
3. Leaves 7–15 by 3–3.6 cm, sparsely pubescent or glabrous beneath; tertiary nerves evident but not prominent; petiole 9–12 mm long **2. *P. densiflora***
3. Leaves 12.5–18 by 6.5–9 cm, persistently scabrid pubescent beneath; tertiary nerves sharply prominent beneath; petiole 14–18 mm long **3. *P. globosa***
1. Fruit sepals aliform, much longer than the nut, spatulate, unequal.
4. Leaves 30–50 by 16–24 cm, very large, white beneath, with 28–36 pairs of close straight nerves **4. *P. macrophylla***
4. Leaves shorter than 20 cm, nerves less than 20 pairs.
5. Leaves (mature trees) glabrous, drying as dark beneath as above; plication obscure; nerves distant, arched, elevated but slender and not prominent beneath; petiole long, slender, geniculate.
6. Leaves 6–9 by 3–4.5 cm; tertiary nerves distant, elevated beneath **5. *P. parvifolia***
6. Leaves 6–16 by 2.3–8 cm; tertiary nerves dense, obscure **6. *P. stellata***
5. Leaves longer than 9 cm, silvery lepidote or puberulent, dull beneath; plication subsistent; nerves dense, hardly arched, prominent beneath.
7. Stipule scars amplexicaul. Leaves broadly elliptic to ovate, base unequal.
8. Leaves glabrous beneath. Connectival appendage longer than anther. Fruit sepals to 15 cm long **7. *P. malaanonan***
8. Leaves  $\pm$  persistently pubescent beneath. Connectival appendage shorter than the anther. Mature fruit sepals to 20 cm long **8. *P. tomentella***
7. Stipule scars short, descending. Leaves not as above.
9. Leaves 6–14 by 2.5–6 cm, glabrescent beneath as also the petiole; nerves to 12 pairs; petiole to 15 mm long **9. *P. lucida***
9. Leaves 10–18 by 4–7 cm; nervation beneath and petiole scabrid pubescent; nerves 14–18 pairs; petiole 15–22 mm long **10. *P. smythiesii***

**1. *Parashorea aptera*** SLOOT. Bull. Jard. Bot. Btzg III, 8 (1927) 377, f. 3; Reinwardtia 5 (1961) 478.

Tall tree. Young twigs, buds, petiole, bracts outside, panicles, calyx parts of corolla exposed in bud and ovary densely evenly  $\pm$  persistently buff pubescent; nerves beneath sparsely  $\pm$  caducously so. *Twig* c. 2 mm  $\varnothing$  apically, much branched,  $\pm$  ribbed, becoming smooth, terete, blackish; stipule scars short, obscure. *Bud* to 6 by 4 mm, ovoid, acute; stipules fugaceous, not seen. *Leaves* 7–17 by 2.8–6 cm, ovate-lanceolate, coriaceous,  $\pm$  distinctly persistently plicate, dull and  $\pm$  silvery stellate puberulent beneath; base cuneate, apex to 1.5 cm long slender acuminate; nerves 6–9(-10) pairs, ascending, rather straight, slender but prominent and drying blackish beneath, applanate above; tertiary nerves very slender, hardly elevated, densely scalariform; midrib prominent beneath, shallowly furrowed above; *petiole* 9–18 mm long, geniculate. *Panicle* to 9 cm long, terminal or axillary, singly or doubly branched, branchlets with 3 prominently pedicellate flowers; *bracts* to 4 by 3 mm, elliptic. *Flower buds* to 6 by 4 mm, ovoid; calyx, petals and ovary densely hirsute. *Sepals* short, broadly ovate-deltoid. *Stamens* slightly exceeding style at

anthesis; filaments compressed, broad, short, attenuate; anthers lorate; appendages very short, hardly exceeding the anthers; *ovary* small, ovoid; style longer than ovary, slender. *Fruit pedicel* to 3 mm long, stout; sepals to 14 by 3 mm, subequal, linear-attenuate, appressed to nut, incrassate at base. *Nut* to 2.5 cm  $\varnothing$ , subglobose, apiculate, densely verrucose.

Distr. *Malesia*: Sumatra (Labuan Batu, E. coast; Rawas, Palembang).

Ecol. Locally frequent below 70 m in lowland forest on sandy soils on hills.

Vern. *Mèranti horsik*, *ngèrawan batu*, *mèrakunyit lawang*.

Note. Some sterile Sumatran collections may represent the Malayan *P. densiflora*.

**2. *Parashorea densiflora*** SLOOT. & SYM. Gard. Bull. S. S. 10 (1939) 373, pl. 24; SYM. Mal. For. Rec. 16 (1943) 100, f. 59A, 60, 61. — *P. aptera* (non SLOOT.) FOXW. Mal. For. Rec. 10 (1932) 243; BURK. Dict. (1935) 1664.

Large tree. Young twigs, petioles and leaves below sparsely pubescent (West coastal Malaya) or glabrous (E. coast), panicle and parts of perianth exposed in



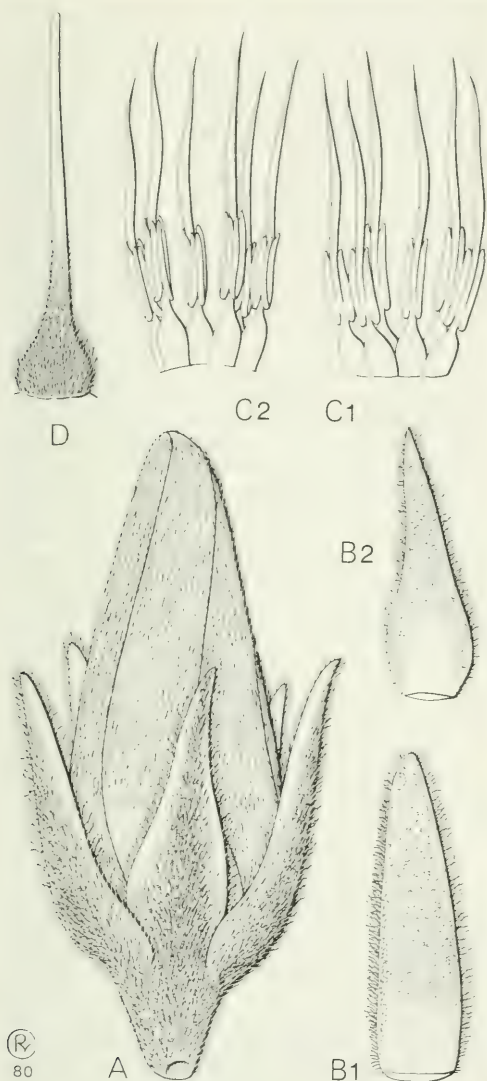


Fig. 54. Flower details in *Parashorea malaanonan* (BLCO) MERR. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C1. stamens from outside, C2. stamens from inside, D. pistil, all  $\times 5$  (PUASA 4643).

bud densely persistently pale brown pubescent, ovary caducously so. Twig  $c. 3$  mm  $\varnothing$ , ribbed, pale to dark brown; stipule scars pale, horizontal, persistent. Bud  $c. 4$  by  $3$  mm, ovoid; stipule to  $12$  mm long, linear, fugaceous. Leaves  $7-15$  by  $3-6.5$  cm, elliptic to ovate, coriaceous,  $\pm$  densely pale purplish stellate lepidote beneath; base cuneate (if  $\infty$ -nerved) or obtuse to subcordate (if few-nerved); acumen to  $1$  cm long,

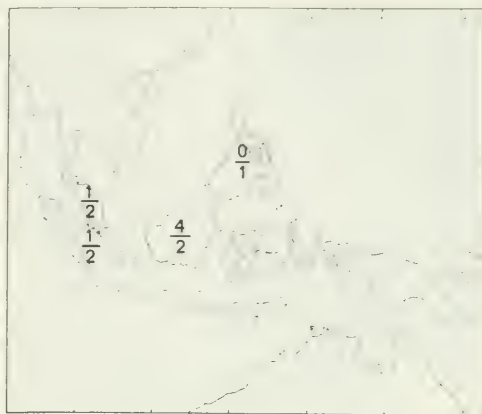


Fig. 55. Density map of *Parashorea* KURZ in Malasia; number of endemics above the hyphen, number of non-endemics below it.

tapering; nerves  $10-20$  pairs, stout and prominent beneath, evident above, ascending, the basal pair frequently branching laterally; tertiary nerves scalariform, sinuate, evident on both surfaces; midrib prominent beneath, obscure and depressed above; petiole  $9-12$  mm long, stout. Panicle to  $6$  cm long,  $c. 3$  mm  $\varnothing$ , stout, terminal or axillary, short, congested. Flower buds to  $6$  by  $4$  mm, ovoid-lanceolate; sepals lanceolate, the 2 inner slightly the smaller, acuminate; petals yellow, tinged purplish at base; stamens in 3 unequal verticils; filaments short, compressed, tapering; anthers oblong, the outer loculi sparsely setose; appendage hardly exceeding anthers, stout; style filiform,  $\pm$  twice length of the ovoid ovary. Fruit pedicel to  $7$  mm long, to  $3$  mm  $\varnothing$ , expanding into the receptacle; calyx lobes to  $12$  by  $3$  mm, subequal, narrowly lorate, acute, becoming reflexed; nut to  $3$  cm  $\varnothing$ , subglobose.

Distr. *Malesia*: Malaya (southern half and in Pahang and Trengganu).

Ecol. Scattered in lowland dipterocarp forest below  $500$  m.

Vern. *Mĕranti pasir, tĕngkawang jantong*.

Note. Collections from the Malayan East coast are glabrescent, with somewhat smaller cordate fewer-nerved leaves; more fertile collections are needed to establish their status, as they are indistinguishable from *P. aptera* when sterile.

3. *Parashorea globosa* SYM. Gard. Bull. S. S. 10 (1939) 375; Mal. For. Rec. 16 (1943) 101, f. 60.

Large tree. Twig apices, leaf buds, stipules, petioles and leaf nervation beneath  $\pm$  densely ochereous to rufous scabrid puberulent. Twig  $c. 3$  mm  $\varnothing$ , stout, becoming rugulose; stipule scars short, somewhat ascending, falcate. Bud  $c. 4$  by  $3$  mm, ellipsoid, obtuse; stipule to  $23$  by  $6$  mm, lanceolate. Leaf  $12.5-18$  by  $6.5-9$  cm, ovate-oblong, thickly coriaceous, rufous

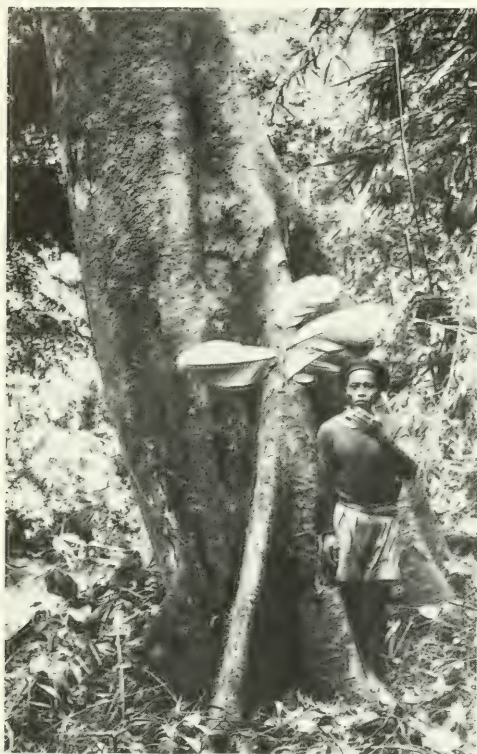


Fig. 56. Stem-base and leaves of *Parashorea macrophylla* WYATT-SMITH *ex* ASHTON. Kuala Belalong, Brunei (Photogr. G.H.S. Wood, SAN 17377).

beneath (mature trees); base subcordate; apex acute to subacuminate; nerves *c.* 18 pairs, prominent beneath, evident above, spreading at leaf base, ascending towards apex; tertiary nerves slender but sharply prominent beneath, evident above; *petiole* 14–18 mm long, stout. *Panicles* and *flowers* unknown. *Fruit* *sepals* to 6 by 3 mm, lorate, obtuse; *nut* to 4 cm  $\varnothing$ , subglobose.

Distr. *Malesia*: Malaya (Perak), Sumatra (Labuan Batu, E. coast).

Ecol. Rare, lowland dipterocarp forest on low-lying land and up valleys at the margin of the plains.

Vern. *Méranti pasir daun bésar*.

**4. *Parashorea macrophylla*** WYATT-SMITH *ex* ASHTON, Gard. Bull. Sing. 19 (1962) 262, pl. 5; ASHTON, Man. Dipt. Brun. (1964) 83, f. 11; *ibid.* Suppl. (1968) 38, pl. 8–9 (habit, bark). — *Parashorea* sp. BROWNE, For. Trees Sarawak & Brunei (1955) 128 — **Fig. 56.**

Young twig, leaf bud, stipule (outside, glabrous within), petiole and inflorescence shortly densely evenly persistently pale ochraceous tomentose. *Twig* to 12 by 5 mm  $\varnothing$  apically, compressed, becoming terete, smooth, amplexicaul; leaf scars large, elliptic, conspi-

cuous. *Bud* to 9 by 0.8 cm, linear, acute, pale cream-brown. *Stipule* to 15 by 2.5 cm, linear, subacute, caducous. *Leaves* alternate, 30–50 by 16–24 cm, subchartaceous, oblong-elliptic, silvery to white below, base subcordate, apex obtuse or shortly acuminate; nerves 28–36 pairs, dense, straight, curved towards the margin, not silvery, with semi-persistent interneural plicate folds; tertiary nerves slender, densely scalariform, diagonal to nerves; midrib stout, rounded beneath, slightly raised above; *petiole* 3–5 cm long, terete. *Panicle* to 16 cm long, terminal or axillary, doubly or trebly branched; branches alternate, branchlets cymose; *bracts* to 4 by 2.5 cm, ovate, acute, cupped, amplexicaul, caducous, densely shortly tomentose outside. *Petals* oblong, obtuse. *Stamens* subequal; filaments short, deltoid; anthers narrowly oblong, the inner pollen sacs somewhat the shorter; appendage prominent, tapering, *c.*  $\frac{1}{2}$  length of anther. *Ovary* conical, shortly pubescent, tapering into a prominent narrowly cylindrical stylopodium. *Fruit* subsessile; *calyx* puberulent (more densely so at base), glabrescent; 3 longer lobes to 22 by 1.8 cm, spatulate, brittle, subacute, tapering to 6 mm broad above the to 16 by 8 mm elliptic shallowly saccate base; fused at the base to form an up to 8 mm deep, to 1 cm broad, cup at the pedicel; 3 shorter lobes to 12 by 0.7 cm, linear, unequal, tapering to 3 mm above the to 5 mm broad and long more prominently saccate base. *Nut* to 2.5 by 1.2 cm, ellipsoid, densely buff tomentose; style remnant to 6 mm long, linear.

Distr. *Malesia*: Borneo (Kapuas hinterland, Sarawak and Brunei).

Ecol. Moist clay rich soils in valleys and gulleys, on and near river banks in inland areas, locally abundant; to 600 m.

Vern. *Përan* (Mal.), *bilat* (Ib.).

**5. *Parashorea parvifolia*** WYATT-SMITH *ex* ASHTON, Gard. Bull. Sing. 19 (1962) 264, pl. 6; ASHTON, Man. Dipt. Brun. (1964) 85, f. 11, pl. 24 (stem); *ibid.* Suppl. (1968) 38; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 195, f. 23.

Young twig, leaf bud, stipule, petiole and panicle sparsely shortly pale yellow-brown tomentose, caducous on twigs and petioles. *Twig* 1 mm  $\varnothing$  apically, terete, smooth, glabrous, dotted with minute pale round lenticels; stipule scars short, slender. *Bud* to 3 by 1 mm, narrowly lanceolate, acute. *Stipule* to 3.5 mm long, narrowly hastate, acute, fugaceous. *Leaves* 6–9 by 3–4.5 cm, elliptic to ovate, glabrous; base broadly cuneate; acumen to 1.5 cm long, narrow to caudate; nerves 8–10 pairs, slender, raised beneath, curved, well spaced, at 50°–60°; tertiary nerves scalariform to subreticulate, widely spaced, *c.* 90° to nerves; midrib slender, prominent beneath, depressed above; *petiole* 1–1.8 cm long, geniculate, pale. *Panicle* to 14 cm long, terminal or axillary, singly branched, straight, pendant; *bracts* and *bracteoles* unknown. *Flower bud* to 4.5 by 3 mm, ellipsoid, obtuse. *Calyx* densely shortly grey-brown tomentose outside, glabrous within, lobes narrowly deltoid, subequal, sub-



acute, not adpressed to corolla in bud. *Petals* elliptic, obtuse, shortly tomentose on parts exposed in bud, pale cream. Inner 5 *stamens* slightly longer than the others, reaching  $\frac{3}{4}$  length of style; filaments broad at base tapering; anther narrowly oblong; appendage to connective short, slightly extruding above anther. *Ovary* subglobose, densely tomentose; style c. 3 times length of ovary, filiform, shortly pubescent in the basal  $\frac{1}{3}$ , otherwise glabrous. *Fruit calyx* puberulent at base, glabrescent, becoming pushed apart by the ripening nut; 3 longer lobes to 8.5 by 1.7 cm, broadly spatulate, obtuse, to 3 mm broad above the to 7 mm long unexpanded slightly thickened base; 2 shorter lobes to 7.5 cm long, often only slightly smaller than longer lobes, subequal. *Nut* to 1.5 by 1.3 cm, ellipsoid, obtuse, verrucose with pale lenticels, buff tomentose; style remnant to 1 mm long, short.

Distr. *Malesia*: Borneo (N.E. of Rejang to Sabah, Bulungan and Tidung).

Ecol. Local, in Mixed Dipterocarp forests on clay rich soil, on ridges in mountains to 1350 m, rarely on river banks.

Vern. *Urat mata bukit* (Brun.), *urat mata daun kēchil* (Sabah), *lantan kuning* (Tidung).

6. *Parashorea stellata* KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 66; Fl. Burma 1 (1877) 117; PIERRE, For. Fl. Coch. 3 (1889) t. 224; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 267; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 104, t. 2, f. 11–12; Indian Trees (1906) 70, fig.; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 388, f. 38; RIDL, Agr. Bull. Str. F.M.S. 6 (1907) 170; Fl. Mal. Pen. 1 (1922) 234; TROUP, Silv. Ind. Trees 1 (1921) 134; FOXW. Mal. For. Rec. 1 (1921) 70; *ibid.* 3 (1927) 63; *ibid.* 10 (1932) 242; GAMBLE, Man. Ind. Timb. (1922) 83; BAKER f. J. Bot. 62, Suppl. (1924) 11; CRAIB, Fl. Siam. Enum. 1 (1925) 144; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 310; *ibid.* ed. 2 (1927) 1126; LECOMTE, Bois de l'Indochine (1926) 113; SLOOT, Bull. Jard. Bot. Btze III, 8 (1927) 373, f. 2, p.p.; BURK, Dict. (1935) 1664; ASHTON, Gard. Bull. Sing. 31 (1978) 26. — *Shorea stellata* DYER, Fl. Br. Ind. 1 (1874) 304; KING, J. R. As. Soc. Beng. 62, 2 (1893) 120. — *Shorea cinerea* FISCHER, Kew Bull. (1926) 460. — *P. lucida* (non (MIQ.)) KURZ, SLOOT, Kew Bull. (1927) 372, p.p.; SYM. Mal. For. Rec. 16 (1943) 102, f. 59B, 60, 62. — *P. poilanei* TARDIEU, Not. Syst. 10, 3 (1942) 136.

Medium-sized or large tree. Panicles, floral ovary and sepals outside densely greyish puberulent, ovary and sepals glabrescent in fruit; leaf undersurface  $\pm$  silvery lepidote; parts otherwise glabrous. *Twig* 1–2 mm  $\varnothing$ , slender, ribbed along the leaf traces, glabrescent; stipule scars short, pale, horizontal. *Buds* to 2 by 2 mm, small, ellipsoid, obtuse; *stipule* to 1.5 cm long, linear, fugaceous. *Leaf* 6–16 by 2.3–7 cm, lanceolate, thinly coriaceous; base cuneate; acumen to 1 cm long, tapering; nerves 8–12 pairs, very slender, elevated beneath, obscure above, steeply ascending, frequently sinuate and obscurely branching; tertiary nerves very slender, evident but hardly elevated, densely scalariform; midrib prominent beneath, shallowly depressed

and obscure above; *petiole* (10–)12–30 mm long, slender, smooth. *Panicle* to 15 cm long, terminal or axillary, slender, lax, many-flowered, doubly branched; branchlets to 2 cm long, bearing to 7 second flowers. *Flower buds* to 2 by 2 mm, small, subglobose; *sepals* ovate, subequal, acute; *corolla* white; *stamens* subequal, yellow; filaments short, broad, compressed; anthers linear-oblong; appendages short, slightly exceeding anthers; ovary subglobose, densely pubescent; style columnar, c.  $1\frac{1}{2}$   $\times$  length of ovary. *Fruit pedicel* to 3 mm long, to 2 mm  $\varnothing$ , expanded into receptacle; calyx lobes to 11 by 1.8 cm, subequal, spatulate, obtuse, ascending, c. 3 mm broad above the narrow thickened base; *nut* to 2 by 1.5 cm, ellipsoid, crowned by an up to 4 mm long filiform tapering style remnant.

Distr. Southern Burma, Thailand, Indochina, and in *Malesia*: Malaya (Trengganu and Perak northwards).

Ecol. Frequent in lowland and hill evergreen dipterocarp forests in seasonal areas, especially in valleys, to 650 m.

Vern. *Gērutu gērutu*.

Note. Collections cited from Sumatra belong correctly to *P. lucida*.

7. *Parashorea malaanonan* (BLCO) MERR. Sp. Blanc. (1918) 271; En. Philip. 3 (1923) 100; REYES, Philip. J. Sc. 22 (1923) 330; SLOOT, Bull. Jard. Bot. Btze III, 8 (1927) 375; in Merr. Pl. Elm. Born. (1929) 202; SYM. Gard. Bull. S. S. 9 (1938) 334, pl. 21; BROWNE, For. Trees Sarawak & Brunei (1955) 128; ASHTON, Man. Dipt. Brun. (1964) 84, f. 11; *ibid.* Suppl. (1968) 38; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 192. — *Mocanera malaanonan* BLCO, Fl. Filip. (1837) 858. — *Dipterocarpus malaanonan* BLCO, Fl. Filip. ed. 2 (1845) 312; *ibid.* ed. 3, 2 (1878) 214; DC. Prod. 16, 2 (1868) 614. — *Shorea malaanonan* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 34; WALP. Ann. 4 (1857) 338; DC. Prod. 16, 2 (1868) 631; F.-VILL. Nov. App. (1880) 21; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 103; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 115; WHITFORD, Bull. Bur. For. Philip. 10 (1911) 64; FOXW. Philip. J. Sc. 6 (1911) Bot. 270; *ibid.* 13 (1918) Bot. 189. — *P. plicata* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 104; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 114; FOXW. Philip. J. Sc. 6 (1911) Bot. 280; *ibid.* 13 (1918) Bot. 194; *ibid.* 67 (1938) 317; WHITFORD, Philip. J. Sc. 6 (1911) Bot. 64. — Fig. 54, 57, 58.

Young twig, leaf bud, stipule, petiole and panicle shortly sparsely pale brown tomentose, glabrescent on petiole. *Twig* to 1.5 mm  $\varnothing$  apically, terete, becoming glabrous, dotted with minute pale round lenticels; stipule scars thin, pale, amplexicaul. *Bud* to 6 by 2 mm, lanceolate to subfalcate, acute. *Leaves* 9–15 by 3.5–7.5 cm, elliptic to ovate, greyish beneath, glabrous; base obtuse to broadly cuneate, subequal; acumen to 1 cm long, acute; margin undulate; nerves 9–14 pairs, straight, with  $\pm$  prominent interneural plicate folds, curved at the margin, prominent beneath; tertiary nerves slender, scalariform, sinuate, at 90°; midrib



Fig. 57. *Parashorea malaanonan* (BLCO) MERR. *a.* Older sterile twig, *b.* younger sterile twig, *c.* fruit, *d.* nut, all  $\times \frac{1}{2}$  (*a* A 281, *b* A 335, *c-d* A 3602).

prominent beneath, slightly raised above; *petiole* 1.2–2 cm long, slightly geniculate. *Panicle* to 18 cm long, terminal or axillary, terete; doubly branched, branchlets to 4 cm long, bearing to 3 flowers; *bracteoles* to 12 by 6 mm, oblong, obtuse, densely pubescent outside, glabrous within. *Bud* to 14 by 8

mm, large. *Flowers* cream. *Calyx* densely brown-buff pubescent outside, more sparsely so near the apex inside; 3 outer lobes narrowly deltoid acute, 2 inner lobes somewhat shorter, narrower. *Petals* hastate, acute, densely tomentose outside, glabrous within. *Stamens* subequal; filaments short, broad at base,





Fig. 58. *Parashorea malaanonan* (BLCO) MERR. *a.* Flowering twig, *b.* apex of twig with terminal bud, both  $\times \frac{1}{2}$  (NOOTEBOOM 1135).

tapering; anthers linear, about twice length of filament; inner pollen sacs shorter, narrower, than outer; appendage to connective longer than anther, reaching to style apex, stout at base, tapering and slender in the apical half, erect. *Ovary* ovoid, shortly pubescent; stylopodium slender, tapering into style, shortly pubescent; style filiform, glabrous, *c.* 4 times length of ovary. *Fruit pedicel* to 4 mm long, broadening into base of fruit. *Fruit calyx* puberulent to glabrescent, more densely pubescent at base; 3 longer lobes to 16 by 1.7 cm, narrowly spatulate, subacute, to *c.* 3 mm broad above the to 5 by 4 mm deltoid shallowly saccate thickened base; shorter lobes to 10 by 0.7 cm, linear, similar at base or somewhat narrower. *Nut* to 1.7 by 1.4 cm, ellipsoid, obtuse, verrucose; style remnant to 6 mm long, linear, tomentose.

*Distr. Malesia:* Borneo (Brunei to Sabah, S. E. to Berau and Nunukan), Philippines.

*Ecol.* Abundant in lowlands of Philippines and E. Sabah, rare in W. Sabah, Brunei and N.E. Sarawak, recorded to 1300 m.

*Uses.* The most important plywood, decking and light construction timber exported from its region.

*Vern.* *Urat mata, urat mata daun lichin* (Borneo), *bagtican, lauan* (Philippines generally), *apnit* (Polillo, Tayabas, Catanduanes, Camarines, Albay, Sorsogon), *bayucan* (Nueva Ecija, Laguna), *binaliuan* (Bulacan), *danlig* (Tayabas, Masbate, Occidental Negros), *malaanonang* (Laguna), *mayatas* (Polillo), *tacuban* (Camarines).

**8. *Parashorea tomentella* (SYM.) MEIJER**, Acta Bot. Neerl. 12 (1963) 320; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 199, f. 25. — *P. malaanonan* var. *tomentella* SYM. Gard. Bull. S. S. 9 (1938) 338, pl. 22. — *P. sp.* THOMAS, Mal. For. 4 (1935) 131, *p.p.*; SYM. ex DESCH, Mal. For. Rec. 12 (1936) 33. — **Fig. 59.**

Large tree. Young twigs, buds, leaf undersurface, petioles, panicles, bracts outside, calyx parts of corolla exposed in bud and ovary densely evenly  $\pm$  persistently pale tawny pubescent. *Twig* *c.* 3 mm  $\varnothing$  apically, much branched, ribbed, becoming terete, smooth, dark brown; stipule scars slender, horizontal, amplexicaul. *Bud* to 10 by 4 mm, lanceolate, acute; *stipule* to 16 by 6 mm, narrowly lanceolate. *Leaves*



Fig. 59. Stem-base of *Parashorea tomentella* (SYM.) MEIJER. Sabah, Tawau, Kalabakan; GANI behind buttress (Photogr. G.H.S. WOOD, Nov. 1955; SAN 17266).

10–20 by 5–10 cm, subcoriaceous, subpersistently plicate, dull but not silvery beneath; margin frequently narrowly subrevolute; base obtuse to subcordate, subequal (peltate in young trees and saplings); apex subacute or to 1 cm long, broadly acuminate; nerves 11–13 pairs, ascending, prominent beneath, somewhat arched; tertiaries densely scalariform, evident and slightly elevated beneath; midrib stout and prominent beneath, elevated above; *petiole* 15–25 mm long, c. 3 mm  $\varnothing$ , stout, hardly geniculate. *Panicle* to 13 cm long, singly or doubly branched, the branchlets bearing to 3 flowers; *bracts* to 10 by 4 mm, lanceolate. *Flower buds* to 15 by 10 mm, broadly lanceolate, flowers very large; *sepals* narrowly deltoid; *stamens*

somewhat shorter than style; filaments compressed, tapering; anthers oblong-linear; appendages somewhat longer than anthers, stoutly acicular; *ovary* small, ovoid; style columnar, c. 5 times length of ovary, stout, puberulent but for the apical  $\frac{1}{3}$ . *Fruit pedicel* c. 3 mm long; *sepals* aliform, 3 longer lobes to 20 by 2.3 cm, spatulate, obtuse; 2 shorter lobes to 10 by 0.8 cm, lorate, acute; *nut* to 2 cm  $\varnothing$ , subglobose, verrucose, apiculate.

Distr. *Malesia*: N. E. Borneo (Sangkulirang to Sandakan).

Ecol. Mixed Dipterocarp forest on flat and undulating land below 200 m. Common.

Vern. *Urat mata beludu*.



Note. Sterile and fruiting collections from the Philippines resembling this species were cited by FOXWORTHY under *P. warburgii* BRANDIS, regarded here as *species dubium*. Without flowering collection their identity remains obscure.

**9. *Parashorea lucida*** (MIQ.) KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 66; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 221; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 104; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 310; ed. 2 (1927) 1126; SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 372, *p.p.*; ASHTON, Man. Dipt. Brun. Suppl. (1968) 38, *in nota sub P. smythiesii*; Gard. Bull. Sing. 31 (1978) 27. — *Shorea lucida* MIQ. Sum. (1862) 487, 191; DC. Prod. 16, 2 (1868) 631; WALP. Ann. 7 (1868) 379. — *Shorea subpeltata* MIQ. Sum. (1862) 488, 191; DC. Prod. 16, 2 (1868) 632; WALP. Ann. 7 (1868) 379; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 219; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 103. — *P. stellata* (non KURZ) SLOOT, Bull. Jard. Bot. Btzig III, 8 (1927) 373, *p.p.*

Large tree. Young twigs, buds, petioles, panicles, bracts outside, calyx, parts of corolla exposed in bud and ovary densely evenly  $\pm$  persistently buff pubescent; nerves beneath sparsely  $\pm$  caducously so. *Twig* c. 2 mm  $\varnothing$  apically,  $\pm$  ribbed, becoming smooth, blackish, terete; stipule scars short, pale, horizontal. *Bud* to 4 by 2 mm, ovoid-apiculate; *stipules* to 5 by 3 mm, narrowly ovate, acute. *Leaves* 6–14 by 2.5–6.5 cm, ovate-lanceolate to elliptic, thinly coriaceous,  $\pm$  distinctly persistently plicate, dull and  $\pm$  silvery stellate beneath; base broadly cuneate to occasionally cordate, subequal; acumen to 1 cm long; nerves 9–12 pairs, slender but prominent beneath, rather straight, dense; tertiary nerves densely scalariform, very slender but distinct beneath; midrib prominent beneath, shallowly furrowed to elevated above; *petiole* 10–20 mm long, hardly geniculate. *Panicle* to 12 cm long, slender, terminal or axillary, singly branched, the branchlets bearing to 6  $\pm$  secund flowers; *bracts* to 4 by 3 mm, elliptic. *Flower bud* to 7 by 4 mm, lanceolate; *sepals* narrowly deltoid; stamens shorter than style; filaments broad, compressed, tapering, short; anthers lorate-oblong; appendages acicular, prominent and longer than anthers; *ovary* small, ovoid, surmounted by a distinct tapering somewhat longer stylopodium; style twice as long as ovary and stylopodium, filiform, somewhat expanding distally. *Fruit pedicel* to 3 mm long, broadening into receptacle; *sepals* aliform, unequal; 3 longer lobes to 8 by 1.7 cm, spatulate, obtuse; 2 shorter lobes to 7.5 by 0.8 cm, narrow; *nut* to 2.5 cm  $\varnothing$ , subglobose or ovoid, apiculate, densely verruculose.

Distr. *Malesia*: Sumatra (central E. & W. of Barisan range), Borneo (Central Kalimantan, Central and N. E. Sarawak).

Ecol. Mixed Dipterocarp forest on hills, to 700 m. Vern. *Itjap, katoeka, damar laut, d. suranti, d. tyirik ayam, mēranti hitam* (Sumatra), *mēruyun* (Iban).

**10. *Parashorea smythiesii*** WYATT-SMITH *ex* ASHTON,

Gard. Bull. Sing. 19 (1926) 266, pl. 7; ASHTON, Man. Dipt. Brun. (1964) 86, f. 11, pl. 23; *ibid.* Suppl. (1968) 38, *p.p.*; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 197, f. 24.

Young tree, leaf bud, stipule, petiole and panicle sparsely shortly pale yellow-brown tomentose, caducous on twigs and petioles. *Twig* 1 mm  $\varnothing$  apically, terete, smooth, glabrous, dotted with minute pale round lenticels; stipule scars short, slender. *Bud* to 3 by 1 mm, narrowly lanceolate, acute. *Stipule* to 3.5 mm long, narrowly hastate, acute, fugaceous. *Leaves* 6–9 by 3–4.5 cm, elliptic to ovate, glabrous; base broadly cuneate; acumen to 1.5 cm long, narrow to caudate; nerves 8–10 pairs, slender, raised beneath, curved, well spaced, at 50°–60°; tertiary nerves scalariform to subreticulate, widely spaced at c. 90° to nerves; midrib slender, prominent beneath, depressed above; *petiole* 1–1.8 cm long, geniculate, pale. *Panicle* to 14 cm long, terminal or axillary, singly branched, straight, pendent; bracts and bracteoles unknown. *Flower bud* to 4.5 by 3 mm, ellipsoid, obtuse. *Calyx* densely shortly grey-brown tomentose outside, glabrous within; lobes narrowly deltoid, subequal, subacute, not adpressed to corolla in bud. *Petals* elliptic, obtuse, shortly tomentose on parts exposed in bud, cream. *Inner 5 stamens* slightly longer than the others, reaching  $\frac{3}{4}$  length of style; filaments broad at base, tapering; anther narrowly oblong; appendage to connective short, slightly protruding above anther; *ovary* subglobose, densely tomentose; style c. 3 times length of ovary, filiform, shortly pubescent in the basal  $\frac{1}{3}$ , otherwise glabrous. *Fruit calyx* glabrescent, puberulent at base, becoming pushed apart by the ripening nut; 3 longer lobes to 8.5 by 1.7 mm, broadly spatulate, obtuse, to 3 mm broad above the to 7 mm long unexpanded slightly thickened base; 2 shorter lobes to 7.5 cm long, often only slightly smaller than longer lobes, subequal. *Nut* to 1.5 by 1.3 cm, ellipsoid, obtuse, verrucose with pale lenticels, buff tomentose; style remnant to 1 mm long, short.

Distr. *Malesia*: Borneo (Rejang hinterland eastwards and northwards to Sabah and Tidung).

Ecol. Scattered in Mixed Dipterocarp forest on clay rich soils, on moist lower slopes, and hillsides to 1000 m.

Vern. *Mēruyun* (Iban), *urat mata batu, urat mata daun puteh*.

#### Doubtful

***Parashorea warburgii*** BRANDIS, J. Linn. Soc. Bot. 31 (1895) 105; FOXW. in Elmer, Leaf. Philip. Bot. 6 (1913) 1954; Philip. J. Sc. 13 (1918) Bot. 194; *ibid.* 67 (1938) 318; MERR. En. Philip. (1923) 800.

Described from a collection of WARBURG from Mindanao, Philippines, consisting of a single fruit undistinguishable from those of *P. malaanonan*. FOXWORTHY associated the name with pubescent-leaved forms from the Philippines otherwise resembling *P. malaanonan* though these may represent *P. tomentella* of Borneo (*q.v.*).



Fig. 60. *Neobalanocarpus heimii* (KING) ASHTON. a. Habit. b. immature fruits, both  $\times \frac{1}{2}$  (a KEP 69424, b KEP 69415).

#### 8. NEOBALANOCARPUS, gen. nov.

ASHTON, Gard. Bull. Sing. 31 (1978) 27. — *Balanocarpus* (non BEDD.) KING, p.p., BRANDIS, p.p., RIDL., p.p., HEYNE, p.p., FOXW., p.p., SYM. (1934) 27, p.p., (1943) 147. — **Fig. 60, 61.**

*Calyx in fructu ut in Balanocarpus* BEDD. (*Hopea* ROXB. pro parte), *floribus maximis antheris lineare-oblongis appendiculatis facile differt.*

Large tree with tall stout buttresses. *Leaves* penninerved, unequal-based, with scalariform tertiary nerves. *Inflorescence* paniculate. *Flowers* medium-sized, secund; *stamens* 15, glabrous, with slender tapering filaments and linear-oblong anthers bearing rudimentary appendages; *ovary* ovoid, with long slender style. *Fruit sepals* short, subequal; *pericarp* splitting into 3 equal valves at germination; cotyledons very unequal; first 4–5 seedling leaves in a whorl.

Distr. Monotypic. Peninsular Thailand (Pattani) and *Malesia*: Malaya.

Note. The possession of short equal fruit sepals, in the presence of a unique androecium structure deprives this single species from the sole character by which it could be allotted to the genera *Shorea* or *Hopea*, underlining the close affinity between these genera. The general appearance of tree and foliage and especially the inflorescence, fruit embryo and mode of germination, suggests that this unsatisfactory genus bears very close affinity with *Hopea* sect. *subsect. Hopea*; the linear anthers are approached by those of *H. plagata* (BLCO) VIDAL, though there the appendage is acicular and prominent.

1. *Neobalanocarpus heimii* (KING) ASHTON, Gard. Bull. Sing. 31 (1978) 27. — *Balanocarpus heimii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 133; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 110; BURN-MURDOCH, Agr.

Bull. Str. & F.M.S. 7 (1908) 386; Trees and Timbers (1911) 3, fig.; BURK. J. Str. Br. R. As. Soc. 81 (1920) 3; J. Mal. Br. R. As. Soc. 1 (1923) 218; Dict. (1935) 204; RIDL. Fl. Mal. Pen. 1 (1922) 247; HEYNE, Nutt. Pl. ed.



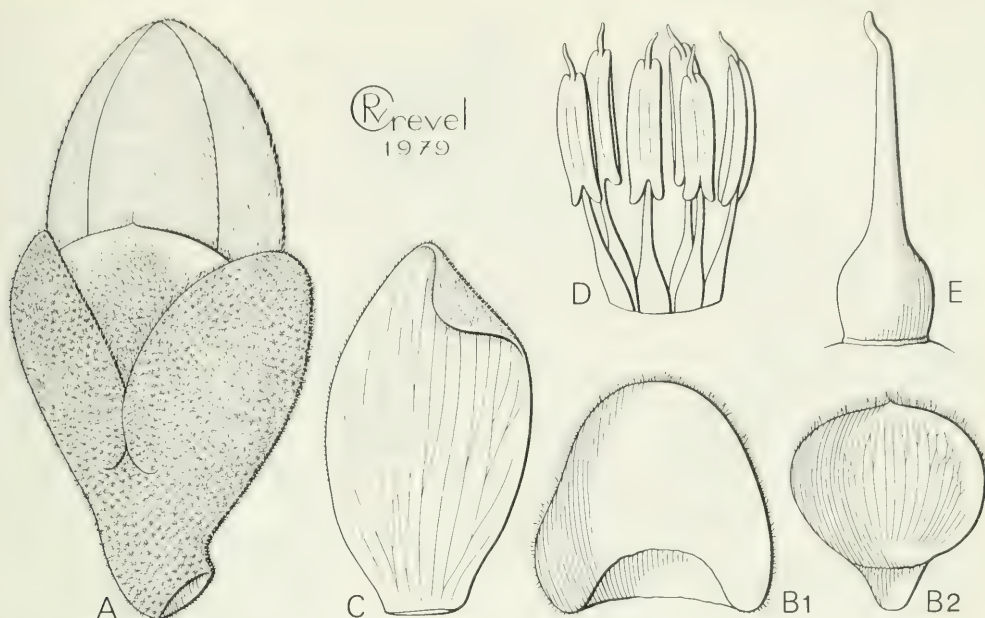


Fig. 61. *Neobalanocarpus heimii* (KING) ASHTON. A. Bud, B1. outer sepal, B2. inner sepal, C. petal, D. stamens from outside, E. pistil, all  $\times 10$  (KEP 94605).

2 (1927) 1128; Foxw. Mal. For. Rec. 1 (1921) 64; *ibid.* 3 (1927) 53; *ibid.* 8 (1930) 10; *ibid.* 10 (1932) 149; J. Mal. Br. R. As. Soc. 5 (1927) 399; STRUGNELL, *ibid.* 9 (1931) 24; SYM. Gard. Bull. S. S. 8 (1934) 27; Mal. For. Rec. 16 (1943) 147, f. 80–82; CORNER, Ways. Trees (1940) 210; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 23. — *Balanocarpus wrayi* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 134. — *Balanocarpus acuminatus* (non BRANDIS) HEIM, Ass. Fr. Adv. Sc. Besançon 1893 (1894) 560, t. 4. — *Pierrea penangiana* HEIM ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 110, *nomen in syn.* — Fig. 60, 61.

Very large flaky barked buttressed tree. Twigs, midrib above, petioles and sepals outside caducous puberulent, leaf buds and panicles persistently so, parts of petals exposed in bud densely buff pubescent. Twig c. 2 mm  $\varnothing$  apically, ribbed, becoming smooth, dotted with minute pale lenticels; stipule scars linear, horizontal. Buds small, ovoid; stipules to 12 mm long, narrowly lorate, spreading, fugaceous. Leaves 7–17 by 2.3–5 cm, lanceolate-falcate, coriaceous; base unequal, cuneate to obtuse; acumen to 1.5 cm long, tapering; nerves 9–12 pairs, ascending, arched, prominent beneath, narrowly depressed above, the basal nerve on the broader (adaxial) side frequently with prominent lateral branchlets; tertiary nerves subreticulate, slender but prominently elevated beneath, obscure above; petiole 5–10 mm long, short. Panicle to

9 cm long, terminal or axillary, singly branched; branchlets to 2.5 cm long, bearing to 7 flowers. Flower buds to 4 by 3 mm, ovoid; sepals broadly ovate, acute, subequal, corolla pale greenish yellow; stamens 15, subequal; filaments tapering, long; anthers linear-oblong, appendages rudimentary; ovary ovoid, glabrous, surmounted by a filiform style twice its length. Fruit pedicel to 2 mm long, to 3 mm  $\varnothing$ , stout, inserted on a  $\pm$  impressed receptacle base; calyx lobes to 20 by 18 mm, subequal, ovate, thickened, saccate, adpressed to the base of the nut; nut to 5.5 by 2.5 cm, oblanceolate, cylindrical, shortly apiculate, lustrous.

Distr. Peninsular Thailand (Pattani) and in Malaysia: Malaya.

Ecol. Widespread in Mixed Dipterocarp forest below 1000 m, especially on undulating land on well drained friable soils.

Uses. The heavy durable timber used to be the best known in Malaya and the 'standard by which other timbers are judged' (SYMINGTON). Now largely replaced owing to the introduction of modern preservative techniques.

Vern. *Chēngal*, *chēngai*, *c. tēmbaga*, *c. batu*, *c. bunga*, *c. dēdap*, *c. mas*, *c. kēmunting*, *c. labu*, *c. sabut*, *c. siput*, *c. tēmbaga*, *c. tēmpurang*.

Note. The young leaves are bronze. Abnormal meiosis was observed by JONG & LETHBRIDGE (Notes R. Bot. Gard. Edinb. 27, 1967, 175).



Fig. 62. *Hopea beccariana* BURCK. a. Flowering branch.  $\times 23$ . — *H. dryobalanoides* MIQ. b. Fruiting branch. c. fruit, d. nut, all  $\times 2/3$  (a SAN 30641, b-d BRUN 3179).



## 9. HOPEA

ROXB. Pl. Corom. 3 (1811) 7, *nom. gen. cons.*, *non* L. 1767; ENDL. Gen. Pl. (1840) 1014, '*Hoppea*'; DC. Prod. 16, 2 (1868) 632; DYER, Fl. Br. Ind. 1 (1874) 308; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 235; HEIM, Rech. Dipt. (1892) 59, *incl. sect. Hancea* (PIERRE) HEIM, *l.c.* 62; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 53; FOXW. Philip. J. Sc. 67 (1938) 273; SYM. Mal. For. Rec. 16 (1943) 108, f. 67 (maps); ASHTON, Gard. Bull. Sing. 20 (1963) 254; Man. Dipt. Brun. (1964) 89; *ibid.* Suppl. (1968) 37; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 203; GUTIERREZ, Act. Manill. 4A, 2 (1968) 3; ASHTON, Blumea 20 (1972) 359; Gard. Bull. Sing. 31 (1978) 28; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 42. — *Neisandra* RAFIN. Sylv. Tellur. (1838) 163. — *Petalandra* HASSK. Cat. Hort. Bog. (1858) 104. — *Balano-carpus* BEDD. For. Man. Bot. (1873) 236 *bis*; HEIM, Rech. Dipt. (1892) 77, *pro sect. Sphaerocarpaceae* HEIM, *l.c.*; SYM. Mal. For. Rec. 16 (1943) 147, *p.p.* — *Hancea* PIERRE, For. Fl. Coch. 4 (1891) *sub t.* 244. — *Pierrea* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 958, *nom. gen. cons.*, *non* HANCE, 1877. — *Dioticarpus* DUNN, Kew Bull. (1920) 337. — *Pierreocarpus* RIDL. *ex* SYM. Gard. Bull. S. S. 8 (1934) 30, *nomen in syn.* — **Fig. 12–13, 62–76.**

Small or medium-sized, occasionally large, trees; bole usually tapering, frequently branching low; buttresses usually thin, sometimes thick; stilt roots and flying buttresses sometimes present; crown, in small species, persistently lanceolate, monopodial, the branches  $\pm$  horizontal and pendent; becoming densely evenly hemispherical in large trees, with many small straight branches radiating from the bole apex. Bark surface at first smooth, chocolate and grey mottled, hoop-marked; remaining so or becoming cracked and flaked, or fissured. Parts with or without indumentum of broad or narrow lobed hairs. *Twigs* slender, usually branching horizontally; stipule scars small, inconspicuous. *Stipules* linear, fugaceous (subpersistent in saplings). Leaves small or medium-sized, or narrowly oblong, large; nerves (see Fig. 64a) either scalariform, with scalariform tertiaries, or 'dryobalanoid' with  $\pm$  indistinct nerves, and with many equally prominent, but more or less shorter, secondaries, and indistinct reticulate tertiaries, superficially resembling those of *Dryobalanops*; or intermediate between these two types: 'subdryobalanoid', with more prominent reticulate or partially scalariform tertiaries, more prominent nerves, and fewer, shorter, intermediates. *Petiole* never geniculate. *Inflorescence* paniculate, slender, terminal or axillary. *Flower buds* small, ovoid or rarely globose. *Sepals* imbricate; 2 outer ovate,  $\pm$  obtuse, thickened; 3 inner suborbicular, frequently mucronate, thin at the margins. *Petals* oblong, connate at base and falling in a rosette. *Stamens* 10, 15 or up to 38 (*H. plagata*), in 1–3 verticils or irregular, falling with the petals; filaments broad and compressed at base, tapering medially and filiform below the anthers, anthers subglobose, tapering apically, latrorse; with 4 pollen sacs, the outer pair somewhat the larger; appendage to connective usually at least twice as long as anther, slender, glabrous or minutely glandular tuberculate. *Ovary* glabrous or tomentose, ovoid and with indistinct stylopodium marked by a ring of hairs at the apex of the ovary, or with a distinct stylopodium and hence pyriform, hour-glass-shaped, or cylindrical; style long or short,

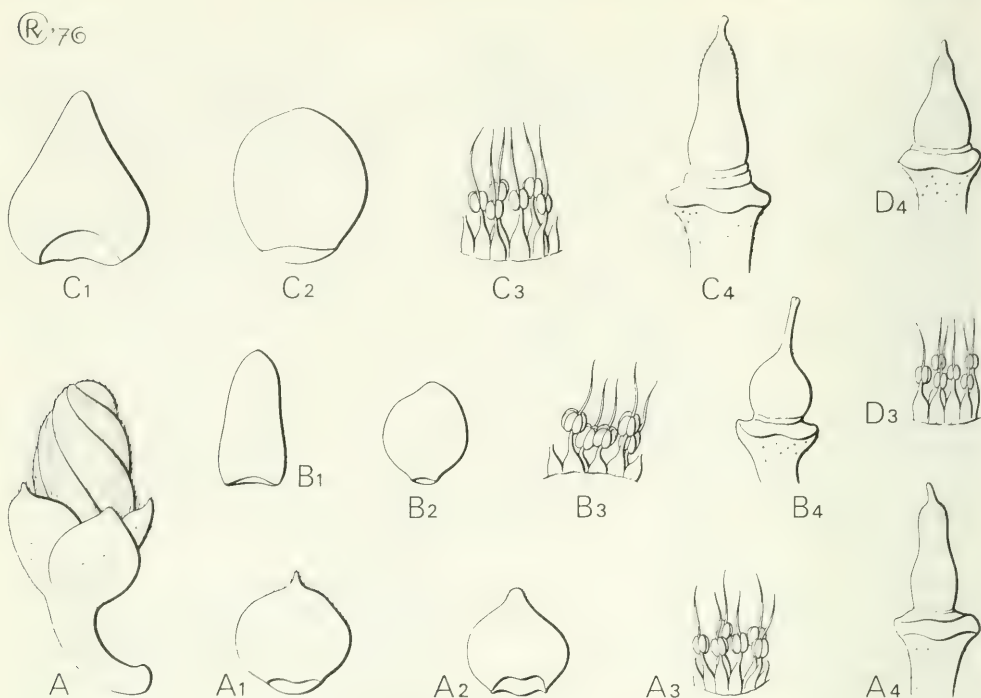


Fig. 63. Flower details in *Hopea* sect. *Dryobalanoides* MIQ. All  $\times 10$ . Sepals drawn from inside. — *H. myrtifolia* MIQ. A. Bud, A1. outer sepal, A2. inner sepal, A3. stamens from outside, A4. pistil. — *H. ferruginea* PARIJS. B1. Outer sepal, B2. inner sepal, B3. stamens from inside, B4. pistil. — *H. beccariana* BURCK. C1. Outer sepal, C2. inner sepal, C3. stamens from outside, C4. pistil. — *H. dyeri* HEIM. D3. Stamens, from outside, D4. pistil (A KEP 99627, B A 4342, C KEP 76753, D BECCARI 2504).

glabrous; stigma minute (except *H. ferrea*). Fruit relatively small: 2 outer fruit calyx lobes prolonged, spatulate; 3 inner lobes short, or 5 short, subequal; lobes thickened and saccate at base. Nut ovoid, usually glabrous, with a distinct apical stylopodium if present in the flower. Pericarp splitting at germination into 3 valves (*H. pachycarpa*) or irregularly; cotyledons photosynthetic, subequal; first pair of leaves opposite, followed by spiral leaves or an initial whorl of 3; branching of sapling mainly at initiation of each period of growth by leader, hence appearing pagoda-like.

Distr. About 102 spp. in Ceylon, Andamans, South and East India, Burma, Thailand, Indochina, continental S. China (Yunnan, Kwangsi, S. Kwantung), Hainan, and 84 spp. throughout Malesia except the Lesser Sunda Islands. Fig. 65.

Ecol. Main canopy or understorey, rarely emergent, trees of lowland evergreen forests; and also semi-evergreen forests where there are more species, many of them local endemics, than any other dipterocarp genus. Several are semi-gregarious, several riparian.

Uses. Though some of the larger species provide a heavy durable construction timber few are common enough to be important economically. Several species in sect. *subsect. Dryobalanoides* produce a clear crystalline resin, *damar mata kuching*, that was formerly a valuable article of commerce.

Notes. Though apparently natural groupings whose typical members are at once recognisable, the



subsections and even sections of this genus are ill-defined in that several species share certain characters from more than one section, in marked contrast with the infrageneric groupings of the closely allied genus *Shorea*. See for a discussion about the subdivision of the genus accepted here ASHTON, Gard. Bull. Sing. 20 (1963) 254.

Pollination in those examined appear to be effected by thrips. Triploidy is known in both emergent (*H. odorata*), main canopy (*H. beccariana*) and understorey species (*H. subulata*). Either or both these factors may explain the high degree of local endemism in the understorey subsections *Sphaerocarpace* and *Pierrea*, and the curious local diversification in New Guinea.

SUBDIVISION OF HOPEA IN MALESIA

- 1. Leaf nervation truly dryobalanoid. *Spp.* 1–26 . . . . . *Sect. Dryobalanoides* *subsect. Dryobalanoides*
- 1. Not so.
- 2. Ovary and stylopodium not constricted between.
- 3. Flowers remote on raceme; bracts subpersistent. *Spp.* 27–39 . . . . . *Sect. Dryobalanoides* *subsect. Sphaerocarpace*
- 3. Flowers dense on raceme; bracts fugaceous. *Spp.* 40–70 . . . . . *Sect. Hopea* *subsect. Hopea*
- 2. Ovary and stylopodium hour-glass-shaped, distinctly constricted. *Spp.* 71–84 . . . . . *Sect. Hopea* *subsect. Pierrea*

KEY TO THE SPECIES

- 1. Leaf nervation truly dryobalanoid. Fig. 67. *Spp.* 1–26.
- 1. *Sect. Dryobalanoides* 1a. *subsect. Dryobalanoides*
- 2. Ovary without distinct stylopodium.
- 3. Midrib obscurely depressed above.
- 4. Ovary glabrous.
- 5. Twig pubescent . . . . . 1. *H. pubescens*
- 5. Twigs glabrous . . . . . 2. *H. foxworthyi*
- 4. Ovary pubescent . . . . . 3. *H. quisumbingiana*
- 3. Midrib evident, ± elevated above.
- 6. Shorter fruit sepals exceeding nut and ± enclosing it.
- 7. Leaf margin revolute.
- 8. Leaf 5–9 by 2–7 cm, thinly coriaceous; stamens 15–18 . . . . . 4. *H. cernua*
- 8. Leaf 11–16 by 6–10 cm, thickly coriaceous; stamens 15 . . . . . 5. *H. coriacea*
- 7. Leaf margin applanate.
- 9. Fruit pedicel to 7 mm long, calyx lobes tuberculate . . . . . 6. *H. longirostrata*
- 9. Fruit pedicel to 2 mm long; calyx lobes not as above.
- 10. Main nerves with axillary domatia, the basal pair not longer than the rest; fruit pendent . . . . . 7. *H. sulcata*
- 10. Main nerves without axillary domatia, the basal pair very long and continuing along 2/3 of the margin; fruit erect on panicle . . . . . 8. *H. fluvialis*
- 6. Shorter fruit sepals shorter than nut and not concealing it.
- 11. Nerves very many, indistinct.
- 12. Leaf base cuneate . . . . . 9. *H. mengerawan*
- 12. Leaf base obtuse . . . . . 10. *H. micrantha*
- 11. Nerves less than 13 pairs.
- 13. Nerves c. 6 pairs, fruit calyx lobes short, subequal . . . . . 11. *H. kerangasensis*
- 13. Nerves more than 8 pairs, fruit calyx lobes unequal, 2 long and aliform.
- 14. Nut to 15 mm long, cylindrical . . . . . 12. *H. vesquei*
- 14. Nut shorter than 11 mm, ovoid.
- 15. Fruit sepals to 6.5 by 1.5 cm; midrib acutely elevated on both surfaces, drying black . . . . . 13. *H. dryobalanoides*
- 15. Fruit sepals to 4 by 0.8 cm; midrib not acute below, not drying black.
- 16. Leaf base unequal; twig apices glabrescent.
- 17. Flower bud to 6 by 3 mm, relatively large; panicle glabrous . . . . . 14. *H. malibato*
- 17. Flower bud less than 3 mm; panicle ± puberulent.
- 18. Leaves small, petiole less than 13 mm long; panicle less than 2 cm long . . . . . 15. *H. johorensis*
- 18. Leaves broadly ovate, petiole 12–17 mm long; panicle to 6 cm long . . . . . 16. *H. latifolia*
- 16. Leaf base equal; twig apices persistently pubescent . . . . . 17. *H. ferruginea*

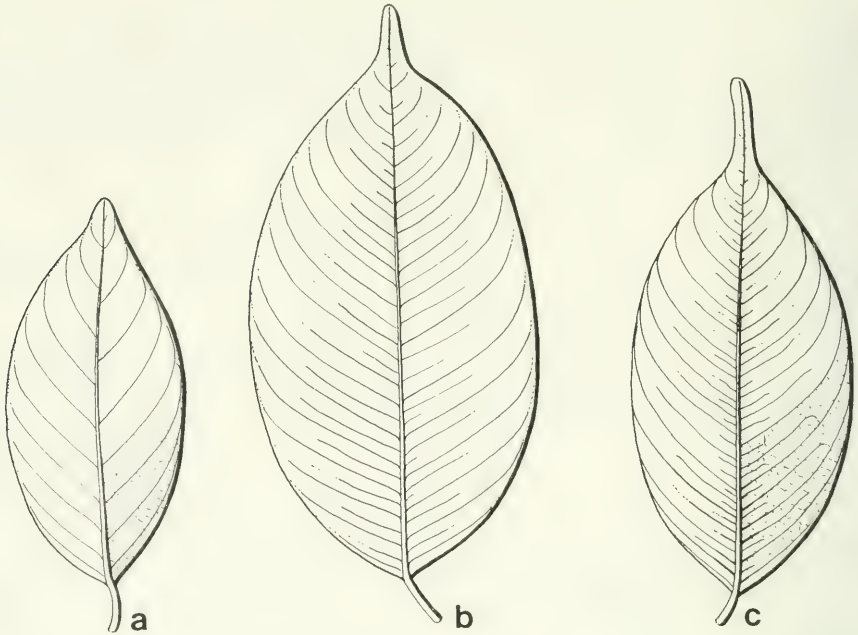


Fig. 64. Three venation types in *Hopea*. — *a*. Scalariform in *H. acuminata* MERR., *b*. dryobalanoid in *H. beccariana* BURCK, *c*. subdryobalanoid in *H. subalata* SYM.

2. Ovary with distinct stylopodium.
19. Midrib above obscure, depressed.
  20. Main nerves very many, *c.* 18 pairs . . . . . 18. *H. pierrei*
  20. Main nerves at most 10 pairs.
    21. Young parts sericeous . . . . . 19. *H. inexpectata*
    21. Young parts glabrous . . . . . 20. *H. griffithii*
19. Midrib evident above.
  22. Stamens 10 . . . . . 21. *H. treubii*
  22. Stamens 15.
    23. Ovary and stylopodium pyriform; nerves at most 12 pairs.
      24. Petiole *c.* 15 mm long, leaf broadly ovate . . . . . 22. *H. beccariana*
      24. Petiole shorter than 10 mm, leaf narrowly ovate-lanceolate . . . . . 23. *H. dyeri*
    23. Ovary and stylopodium cylindrical; nerves at least 13 pairs, 13–16 pairs.
      25. Twigs and petioles pubescent . . . . . 24. *H. myrtifolia*
      25. Twigs and petioles glabrous.
        26. Leaves applanate . . . . . 25. *H. pedicellata*
        26. Leaves prominently revolute at least at base . . . . . 26. *H. altocollina*
1. Leaf nervation not truly dryobalanoid. Compare fig. 64a & c.
  27. Ovary and stylopodium not constricted between.
    28. Flowers remote on raceme; bracts subpersistent, corolla dark coloured. *Spp.* 27–39.
      1. *Sect. Dryobalanoides* 1b. subsect. *Sphaerocarpace*
  29. Leaf nervation scalariform. Fig. 64a.
    30. Fruit calyx lobes short, subequal . . . . . 27. *H. aequalis*
    30. Fruit calyx lobes unequal: 2 long, aliform.
      31. Nerves 11–13 pairs; leaves pale beneath . . . . . 28. *H. rudiformis*
      31. Nerves (13–)16–19 pairs; leaves not pale beneath.
        32. Two longer fruit sepals to 12 cm long . . . . . 29. *H. nervosa*
        32. Two longer fruit sepals not exceeding 8 cm . . . . . 30. *H. sublanceolata*
  29. Leaf nervation subdryobalanoid. Fig. 64a.



- 33. Lamina base obtuse.
- 34. Fruit sepals unequal, 2 aliform . . . . . 31. *H. nigra*
- 34. Fruit sepals short, subequal.
- 35. Petiole 3–6 mm long . . . . . 32. *H. sphaerocarpa*
- 35. Petiole 7–10 mm long . . . . . 33. *H. mesuoides*
- 33. Lamina base cuneate.
- 36. Fruit sepals unequal.
- 37. A single fruit sepal exceeding the nut, shortly lorate . . . . . 34. *H. subalata*
- 37. Two fruit sepals aliform, spatulate.
- 38. Base of fruit sepals auriculate . . . . . 35. *H. auriculata*
- 38. Base of fruit sepals not auriculate . . . . . 36. *H. montana*
- 36. Fruit sepals all shorter than the nut, subequal.
- 39. Stamens 10 . . . . . 37. *H. vaccinifolia*
- 39. Stamens 15.
- 40. Ovary and stylopodium puberulent . . . . . 38. *H. bracteata*
- 40. Ovary and stylopodium glabrous . . . . . 39. *H. brachyptera*
- 28. Flowers dense on raceme; bracts fugaceous; corolla pale. *Spp.* 40–69.
- 2. *Sect. Hopea 2a. subsect. Hopea*
- 41. Nerves united into a prominent continuous intramarginal nerve midway between midrib and margin . . . . . 40. *H. celtidifolia*
- 41. Nerves without intramarginal nerve.
- 42. Fruit sepals suborbicular; stamens 10 . . . . . 41. *H. dasyrrhachis*
- 42. Fruit sepals spatulate or, if suborbicular, then stamens 15.
- 43. Nerves on average at least 13 pairs.
- 44. Leaf base obtuse,  $\pm$  equal.
- 45. Leaf at least 10 by 3.5 cm; petiole at least 11 mm long; shorter fruit sepals shorter than nut . . . . . 42. *H. similis*
- 45. Leaf at most 11 by 4 cm; petiole at most 8 mm long; 1 or the 3 shorter fruit sepals frequently lorate and exceeding nut . . . . . 43. *H. forbesii*
- 44. Leaf base prominently unequal, generally cordate on one side; or subequal, subcordate on both sides.
- 46. Leaf glaucous beneath; stylopodium truncated, pubescent . . . . . 44. *H. helferi*
- 46. Leaf not glaucous; stylopodium tapering, glabrous.
- 47. Fruit sepals short, subequal . . . . . 45. *H. aptera*
- 47. Fruit sepals unequal, 2 aliform.
- 48. Base of leaf subequal, subcordate . . . . . 46. *H. ultima*
- 48. Base of leaf prominently unequal.
- 49. Young parts evenly pubescent, leaf beneath glabrous, drying dull greyish . . . . . 47. *H. novoguineensis*
- 49. Young parts scabrid pubescent; leaf nervation beneath  $\pm$  pubescent; leaf drying coppery brown to lustrous beneath.
- 50. Ripe nut to 8 by 6 mm; tertiary nerves beneath scabrous . . . . . 48. *H. scabra*
- 50. Ripe nut to 16 by 9 mm, tertiary nerves beneath glabrescent . . . . . 49. *H. papuana*
- 43. Nerves 12 pairs or less.
- 51. Stamens 10.
- 52. Leaf elliptic-lanceolate, nerves ascending.
- 53. Leaf drying coppery-brown; nerves 9–12 pairs, domatia small but distinct, puberulent . . . . . 50. *H. acuminata*
- 53. Leaf drying pale grey-brown; nerves 6–8 pairs; domatia obscure or absent . . . . . 51. *H. depressinerva*
- 52. Leaf ovate, drying dark grey-brown; nerves patent; domatia pubescent . . . . . 52. *H. sangal*
- 51. Stamens 15 or more.
- 54. Connectival appendages shorter than anthers; sapling leaves peltate . . . . . 53. *H. ferrea*
- 54. Connectival appendages at least as long as anthers; sapling leaves not peltate.
- 55. Ovary and stylopodium cylindrical or pyriform, the stylopodium stout, no longer than the ovary.
- 56. Style prominent, as long as ovary.
- 57. Nerves c. 11 pairs, very slender, distinct; midrib evident, applanate, above . . . . . 54. *H. odorata*
- 57. Nerves 7–9 pairs, very slender, distinct; midrib evident, applanate, above . . . . . 55. *H. centipeda*
- 56. Style very short.
- 58. Stamens 32–38 . . . . . 56. *H. plagata*
- 58. Stamens 15

59. Leaf base obtuse; domatia pore-like, prominently swollen.
60. Leaf thickly coriaceous, undersurface greyish lepidote . . . . . 57. *H. nutans*
60. Leaf chartaceous, undersurface shagrened . . . . . 58. *H. bancana*
59. Leaf base cuneate; domatia not as above.
61. Nerves c. 5 pairs . . . . . 59. *H. pentanervia*
61. Nerves at least 6 pairs.
62. Leaf base distinctly unequal.
63. Midrib above and young twigs pubescent . . . . . 60. *H. basilanica*
63. Midrib above and young twigs glabrous . . . . . 61. *H. andersonii*
62. Leaf base  $\pm$  equal.
64. Panicle densely persistently buff pubescent.
65. Ovary and stylopodium ovoid . . . . . 62. *H. ovoidea*
65. Ovary and stylopodium cylindrical, truncate . . . . . 63. *H. semicuneata*
64. Panicle glabrous.
66. Panicles axillary. Ovary and stylopodium cylindrical-truncate. Leaf nerves to 7 pairs . . . . . 64. *H. megacarpa*
66. Panicles ramiflorous. Ovary and stylopodium narrowly pyriform. Leaf nerves at least 9 pairs . . . . . 65. *H. samarensis*
55. Gynoecium glabrous, narrow; stylopodium longer than ovary, slender, merging with the very short style.
67. Leaves equal at base, petiole (7-)10-16 mm long.
68. Nerves  $\pm$  depressed above, without domatia . . . . . 66. *H. nodosa*
68. Nerves appanate to somewhat elevated above, with domatia towards leaf base . . . . . 67. *H. celebica*
67. Leaves distinctly unequal at base, petiole 5-9(-10) mm long.
69. Leaves mostly with prominent pore-like glabrous axillary domatia . . . . . 68. *H. iriana*
69. Leaves without distinct domatia.
70. Leaf undersurface glabrous; fruit sepals aliform . . . . . 69. *H. glabrifolia*
70. Leaf undersurface stellate lepidote; fruit sepals short, becoming reflexed . . . . . 70. *H. gregaria*
27. Ovary and stylopodium hour-glass-shaped, distinctly constricted medially; stylopodium tapering into the short style. *Spp. 70-83 2. Sect. Hopea 2b. subsect. Pierrea*
71. Leaves broad, base equal, cuneate on both sides; panicles solitary.
72. Fruit calyx lobes unequal, 2 aliform, spatulate . . . . . 71. *H. glaucescens*
72. Fruit calyx lobes shorter than the nut, subequal . . . . . 72. *H. wyatt-smithii*
71. Leaves narrow, base  $\pm$  unequal, obtuse to cordate at least on one side; panicles usually more than 1-axillary.
73. Tertiary nerves remotely subreticulate; petiole short, stout (flowers and fruit unknown) . . . . . 73. *H. polyalthioides*
73. Tertiary nerves not as above or, if so, then petiole slender.
74. Fruit sepals short, subequal.
75. Nerves 9-12 pairs; panicles shorter than 5 cm.
76. Tertiary nerves densely scalariform . . . . . 74. *H. cagayanensis*
76. Tertiary nerves remotely scalariform . . . . . 75. *H. paucinervis*
75. Nerves at least 12 pairs; panicles exceeding 6 cm long.
77. Tertiary nerves subreticulate . . . . . 76. *H. apiculata*
77. Tertiary nerves scalariform. Fig. 64a . . . . . 77. *H. pachycarpa*
74. Fruit sepals unequal, aliform, spatulate.
78. Nerves 6-8 pairs, tertiaries remote . . . . . 78. *H. bilitonensis*
78. Nerves at least 12 pairs
79. Leaves prominently bullate between the tertiary nerves . . . . . 79. *H. bullatifolia*
79. Leaves not as above.
80. Base of fruit calyx lobes auriculate . . . . . 80. *H. pterygota*
80. Base of fruit calyx lobes not auriculate.
81. Leaves with prominent pubescent axillary domatia.
82. Nerves at least 16 pairs.
83. Leaves at most 15 cm long; fruit sepals to 7.5 cm long . . . . . 81. *H. philippinensis*
83. Leaves at least 15 cm long; fruit sepals exceeding 8 cm long . . . . . 82. *H. mindanensis*
82. Nerves at most 12 pairs . . . . . 65. *H. samarensis*
81. Leaves without prominent axillary domatia.
84. Leaves typically 13-22 by 4-7 cm; nerves 12-15 pairs . . . . . 83. *H. tenuinervula*
84. Leaves typically 27-46 by 8-15 cm; nerves 16-30 pairs . . . . . 84. *H. enicosanthoides*



1. Section *Dryobalanoides*

MIQ. Sum. (1861) 491, 192 as subgenus; BURCK. Ann. Jard. Bot. Btzig 6 (1887) 239; HEIM, Rech. Dipt. (1892) 62; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 66; FOXW. Philip. J. Sc. 6 (1911) Bot. 265; Mal. For. Rec. 10 (1932) 132; SYM. Mal. For. Rec. 16 (1943) 108; ASHTON, Gard. Bull. Sing. 20 (1963) 258; Man. Dipt. Brun. (1964) 90; GUTIERREZ, Act. Manil. 4A, 2 (1968) 25. — **Fig. 63, 70.**

Nervation dryobalanoid or subdryobalanoid (*H. nervosa*, *H. sublanceolata* excepted). Bark surface smooth, fissured or cracked, not evenly flaky. Wood with numerous chambered parenchyma strands; rays not markedly heterogeneous.

1a. Subsection *Dryobalanoides*

*Hancea* PIERRE. — *Hopea* sect. *Hancea* (PIERRE) HEIM.

Nervation dryobalanoid. Bracts fugaceous. Corolla pale (*H. griffithii* excl.); panicles regularly branched, branchlets short; flowers many. Ovary and stylopodium ovoid or pyriform, rarely truncate.

Distr. Cochinchina, S.E. and Peninsular Thailand and Burma; in *Malesia*: Malaya, Sumatra, Borneo, Philippines, West New Guinea.

1. *Hopea pubescens* RIDL. Fl. Mal. Pen. 1 (1922) 239; FOXW. Mal. For. Rec. 10 (1932) 139; BURK. Dict. (1935) 1194; SYM. Mal. For. Rec. 16 (1943) 140, f. 69.

Medium-sized fissure-barked tree with small  $\pm$  stilted buttresses. Twigs, petioles, midrib above and panicle densely persistently tawny puberulent, petals outside cream pubescent, otherwise glabrous. *Twig* c. 1 mm  $\varnothing$  apically, much branched, terete, becoming dark brown; internodes 5–12 mm long, short; stipule scars obscure. *Leaf bud* minute; *stipules* fugaceous. *Leaves* 2.5–6 by 1.3–2.8 cm, small, lanceolate, coriaceous; base broadly abruptly cuneate; acumen to 1 cm long, caudate; nervation dryobalanoid, main nerves c. 12 pairs with  $\pm$  shorter secondaries, hardly evident beneath, obscure above; midrib sharply prominent beneath, obscure and depressed above; *petiole* 4–6 mm long, c. 1 mm  $\varnothing$ , slender. *Panicles* to 3 cm long, axillary or sometimes terminal, short, singly branched; branches to 8 mm long, bearing to 4 second flowers. *Flower buds* to 3 by 1.5 mm, ellipsoid, small. *Sepals* ovate, acute, the outer 2 somewhat the longer and narrower. *Petals* cream. *Stamens* 15; filaments slender, tapering, compressed; appendages slender, somewhat papillose, c. 2 times length of the broadly oblong anthers. *Ovary* ovoid, glabrous, crowned by a somewhat longer columnar style. *Fruit pedicel* to 1.5 mm long, very slender. 2 longer calyx lobes to 30 by 6 mm, spatulate, obtuse, c. 1 mm broad above the to 3 by 1.5 mm narrowly elliptic saccate base; 3 shorter lobes to 3 by 2 mm, ovate, acuminate. *Nut* to 5 by 4 mm, ovoid, very shortly apiculate.

Distr. *Malesia*: Malaya (Kelantan, Pahang).

Ecol. Frequent, sometimes abundant, on well-drained flat land and low hills.

Vern. *Mĕrawan bunga*, *m. pipit*, *pĕngarawan*.

2. *Hopea foxworthyi* ELMER, Leaf. Philip. Bot. 4 (1912) 1469; FOXW. Philip J. Sc. 67 (1938) 282, *p.p.*; GUTIERREZ, Act. Manil. 4A, 2 (1968) 32, f. 6, pl. 2. — *H. pierrei* (non HANCE) FOXW. Philip. J. Sc. 6 (1911) Bot. 265, *p.p.*; *ibid.* 13 (1918) Bot. 184; WHITFORD, Bull. Bur. For. Philip. 10 (1911) 76; BROWN & MATTHEWS, Philip. J. Sc. 9 (1914) Bot. 439, 481; MERR. En. Philip. 3 (1923) 94; REYES, Philip. J. Sc. 22 (1923) 339. — *H. glutinosa* ELMER, Leaf. Philip. Bot. 4 (1912) 1470; FOXW. Philip. J. Sc. 13 (1918) Bot. 184.

Medium-sized smooth barked narrowly buttressed tree. Twig apices, leaf buds, petioles, base of peduncle, ovary and stylopodium fugaceous puberulent, otherwise glabrous. *Twigs* c. 1 mm  $\varnothing$  apically, slender, much branched, terete, rugulose, dark brown. *Leaves* 2.7–6.5 by 1–2.5 cm, lanceolate, thinly coriaceous, lustrous; margin subrevolute; base  $\pm$  equal, cuneate, apex with to 1.5 cm long slender caudate acumen; nerves c. 10 pairs, very slender and  $\pm$  obscure on both surfaces or slightly elevated beneath, slightly depressed above, ascending, arched, with a few shorter obscure secondary nerves; tertiary nerves reticulate, obscure; midrib sharply prominent beneath, obscure and depressed above; *petiole* 5–8 mm long, very slender. *Panicles* to 1.5 cm long, short, slender, axillary or terminal, singly branched; branchlets few, bearing to 5 flowers, *bracts* and *bracteoles* fugaceous. *Flower bud* to 5 by 3 mm, ellipsoid, rather large. 2 outer *sepals* ovate, acute; 3 inner suborbicular, subacute. *Stamens* 15; filaments compressed at base, tapering and filiform below the subglobose anthers;

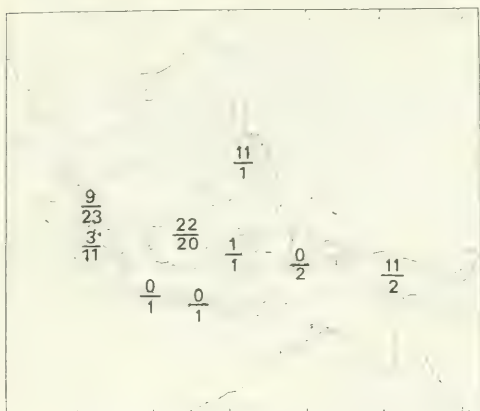


Fig. 65. Density map of *Hopea* ROXB. in Malesia; number of endemics above the hyphen, number of non-endemics below it.

appendage about twice as long as anther, slender. *Ovary* ovoid, glabrous, without stylopodium; style about twice as long as ovary, filiform, tapering. *Fruit pedicel* c. 1 mm long, short; 2 longer *calyx lobes* to 3.5 by 1 cm, broadly spatulate, obtuse, tapering to 2 mm broad above the to 5 by 4 mm ovate saccate thickened base; 3 shorter lobes to 5 by 5 mm, broadly ovate, acute; *nut* to 15 by 5 mm, narrowly ovoid, resinous, tapering to a prominent attenuate apiculus.

Distr. *Malesia*: Philippines (Sibuyan).

Ecol. Locally common on red sticky volcanic soil along ridges at 600–700 m, in seasonal semi-evergreen forest.

Vern. *Mangachapuy*.

Note. Collections cited by FOXWORTHY from islands other than Sibuyan belong to *H. malibato*.

**3. *Hopea quisumbingiana* GUTIERREZ, Act. Manil. 4A, 2 (1968) 31, f. 5, pl. 1.**

Twig apices caducous grey-brown puberulent, ovary and parts of petals exposed in bud persistently so. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched, becoming dark chocolate-brown; stipules minute. *Leaves* 5–7 by 2.5–3.2 cm, ovate-lanceolate, subcoriaceous; base broadly cuneate; acumen to 8 mm long, caudate; nervation dryobalanoid; nerves 9–13 pairs, very slender but evident beneath, sometimes with a few tomentose domatia, with shorter secondaries, tertiary nerves obscure; midrib slender but prominent beneath, obscure and depressed above; *petiole* 6–8 mm long, slender. *Panicles* to 3.5 cm long, terminal or to 2-axillary, singly branched, branchlets to 1 cm long, bearing to 5 secund flowers. *Flower buds* to 3 by 2 cm, ellipsoid. *Sepals* broadly ovate, subacute, subequal. *Stamens* 15, subequal; filaments broadly compressed at base, tapering and filiform distally; appendage aristate, c. twice length of subglobose anthers. *Ovary* ovoid, tapering into the equally long columnar taper-

ing style; ovary and basal  $\frac{1}{2}$  of style pubescent. *Fruit* unknown.

Distr. *Malesia*: Philippines (Samar, once collected).

**4. *Hopea cernua* T. & B. Nat. Tijds. N. I. 29 (1867) 252; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 4, fig.; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 241; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 244; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 71, t. 2, f. 8–9; MERR. En. Born. (1921) 402; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 238; ASHTON, Man. Dipt. Brun. Suppl. (1968) 49, f. 6; Gard. Bull. Sing. 31 (1978) 28. — *H. microcarpa* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 954. — *Hancea cernua* PIERRE, For. Fl. Coch. 4 (1891) sub t. 244. — *H. argentea* MEIJER, Acta Bot. Neerl. 12 (1963) 348, pl. 13; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 207; ASHTON, Man. Dipt. Brun. Suppl. (1968) 47, f. 6.**

Medium-sized buttressed tree with flying buttresses, bark becoming thickly flaky. Leaf bud, young twig and petiole caducous grey-brown pubescent. *Twig* c. 1 mm  $\varnothing$ , terete, smooth; stipule scars small, obscure. *Bud* to 3 by 2 mm, ellipsoid, obtuse. *Stipule* to 4 by 2 mm, lorate, elliptic, caducous. *Leaves* 5–15 by 2–5 cm, elliptic to ovate, subcoriaceous,  $\pm$  distinctly silvery lepidote beneath; base cuneate, equal, acumen to 6 mm long; nerves 10–12 pairs, slender but distinctly elevated and even prominent beneath, often with a few axillary pore-like pubescent domatia; with stout secondaries; midrib slender, slightly raised on both surfaces; *petiole* 7–9 mm long, slender. *Panicle* to 3 cm long, glabrous, terminal or axillary, terete; singly branched, branchlets bearing to 4 flowers; *bracteoles* c. 1 mm long, small, linear, glabrous, fugaceous. *Flower bud* to 5 by 4 mm, fusiform; *sepals* narrowly ovate, acute to subacuminate, subequal, glabrous, usually patent; *petals* lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15–18, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the subglobose anthers; appendage to connective slender, 2–3 times length of anther, minutely papillose towards base. *Ovary* ovoid, glabrous. *Style* c.  $1\frac{1}{2}$  times length of ovary, sometimes slightly swollen in the villous basal  $\frac{1}{3}$ . *Fruit* glabrous; *pedicel* to 2 mm long; 2 longer *calyx lobes* to 6.5 by 12 cm, spatulate, obtuse, c. 4 mm broad above the to 5 by 5 mm ovate thickened saccate base; 3 shorter lobes to 1.5 cm long, lanceolate, acute, similar at base. *Nut* to 7 by 5 mm, ovoid, glabrous, apiculate.

Distr. *Malesia*: Banka, ? Sumatra, N. and E. Borneo.

Ecol. Local, in Mixed Dipterocarp forest on fertile soils especially on intermediate and basic igneous rocks including limestone, to 1650 m.

Vern. *Selangan urat* (Sabah), *huis timbul* (Sar.), *tēmang djankar*, *damar putih*, *d. puteh* (Indon. Borneo).

**5. *Hopea coriacea* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 237; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64;**



MERR. En. Born. (1921) 402; ASHTON, Gard. Bull. Sing. 31 (1978) 28. — *H. kelantanensis* SYM. J. Mal. Br. R. As. Soc. 19 (1941) 144, pl. 3; Mal. For. Rec. 16 (1943) 130, f. 69. — *H. garangbuaya* ASHTON, Gard. Bull. Sing. 19 (1962) 256, pl. 2; Man. Dipt. Brun. (1964) 101, f. 12; *ibid.* Suppl. (1968) 51.

Tall flaky or fissure-barked tree with  $\pm$  prominent buttresses. Glabrous but for petals. *Twig* to 2 mm  $\varnothing$  apically, stout, terete, smooth; *bud* ovoid, to 2 by 1 mm. *Stipule* to 4 mm long, linear, fugaceous. *Leaves* 11–16 by 6–10 cm, broadly ovate, thickly coriaceous, base obtuse; acumen to 1.2 cm long, narrow, margin slightly revolute; nerves 8–11 pairs, dryobalanoid but relatively prominent, strongly arched, at 60°–70° with short secondaries; tertiary nerves rather distinct, densely scalariform, at 90°; midrib broad, prominently rounded beneath, slightly raised above; *petiole* 2–2.5 cm long, stout. *Panicle* to 9 cm long, terminal or axillary, to 2-axillary, terete, glabrous; regularly singly branched, branchlets to 3 cm long, bearing to 6 second flowers; *bracts* and *bracteoles* unknown. *Flower bud* to 3 by 2.5 mm, ellipsoid, relatively large, distinctly pedicellate. *Calyx* glabrescent outside, fimbriate; 2 outer lobes ovate, acuminate, 3 inner lobes thin, suborbicular, terete. *Petals* to 1.3 cm long, narrowly lanceolate, acute, pubescent in parts exposed in bud, otherwise glabrous. *Stamens* 15, in 3 whorls, pairs alternating with single stamens; filaments slender, tapering; anthers oblong, the anterior cells slightly the larger; appendage to connective 2–3 times length of anther, prominently glandular tuberculate towards base. *Ovary* ovoid, glabrous at base, tapering gradually into style; apex of ovary and basal half of style densely setose; style filiform, tapering, as long as ovary; no distinct stylopodium. *Fruit calyx* glabrous, tapering into pedicel, lobes closely imbricate at base, hiding the nut, 2 longer to 7 by 1.5 cm, spatulate, somewhat tapering above the auriculate obtuse shallowly saccate unthickened base; 2 shorter to 2 by 1.2 cm, ovate, acute, similar at base. *Nut* to 18 by 9 mm, narrowly ovoid, with to 2 mm long apiculus; frequently exuding resin.

Distr. *Malesia*: Malaya (E. coast: Kelantan to Pahang); Borneo (Kapas valley, Sarawak and Brunei).

Ecol. Local, on or near sandy river banks, rarely (in Brunei) on hills to 200 m.

Vern. *Giam hantu* (Mal.), *damar mēlapi* (Kapas), *garang buaya*, *arang bayar* (Brun.).

**6. *Hopea longirostrata*** ASHTON, Gard. Bull. Sing. 22 (1967) 277, pl. 23; Man. Dipt. Brun. Suppl. (1968) 52, f. 7.

Smooth or patchily flaky-barked tree of medium size. All parts apparently glabrous. *Twig* c. 2 mm  $\varnothing$  apically, much branched, terete, smooth; stipule scar short, obscure. *Bud* to 2 by 2 mm, subglobose, obtuse. *Stipule* caducous, unknown. *Leaves* 7–9 by 3–5 cm, ovate-elliptic, coriaceous; base obtuse; acumen to 1.5 cm long, subcaudate; nervation dryobalanoid; main nerves c. 12 pairs, obscure, unraised, with subequal

long intermediates; midrib slender but prominent above, acute, elevated beneath. *Petiole* 7–10 mm long, geniculate, blackish. *Flower* unknown. *Panicle* and fruit glabrous. *Panicle* to 4 cm long, terminal or 3-axillary; singly branched, branchlets bearing to 5 flowers. *Pedicel* c. 5 mm long, uniquely long. 2 longer *calyx lobes* to 24 by 6 mm, spatulate, tapering to 3 mm and terminating abruptly in a small incrassate central tubercle; 3 shorter lobes to 15 mm long, linear to spatulate, acute or obtuse, similar at the base. *Nut* to 6 by 4 mm, ovoid; style remnant to 2 mm long.

Distr. *Malesia*: Borneo (Central Sarawak).

Ecol. Rare, lowland Mixed Dipterocarp forest.

**7. *Hopea sulcata*** SYM. Gard. Bull. S. S. 10 (1939) 358, pl. 20; Mal. For. Rec. 16 (1943) 145, f. 68G, 69, 79. — *H. micrantha* (non HOOK. f.) FOXW. Mal. For. Rec. 10 (1932) 135, p.p.

Medium-sized fissure-barked small-buttressed tree, at first with stilt roots. Twigs, petioles and panicles silvery lepidote, domatia and petioles outside cream pubescent, parts otherwise glabrous. *Twig* c. 1 mm  $\varnothing$  apically, slender, dark brown,  $\pm$  prominently ribbed; stipule scars obscure. *Leaf buds* minute, ovate, stipules minute, linear, fugaceous. *Leaves* 4–10 by 1.7–4 cm, ovate; lanceolate, falcate, relatively small; base cuneate, shortly decurrent, subequal; acumen to 2 cm long, slender, caudate; nervation dryobalanoid, main nerves c. 10 pairs with many shorter unequal secondaries, arched,  $\pm$  distinctly elevated beneath,  $\pm$  depressed or obscure above, the main nerves with  $\pm$  prominent axillary tomentose domatia; midrib elevated on both surfaces; *petiole* 5–11 mm long, slender. *Panicle* to 6 cm long, terminal or axillary, singly branched; branchlets to 16 mm long, bearing to 6 second pale yellow flowers. *Flower bud* to 2 by 1 mm, ovoid. *Sepals* ovate, acute, the outer 2 narrower, longer than inner 3. *Stamens* 15, filaments broadly compressed at base, tapering, appendage aristate, c. 3  $\times$  length of subglobose anthers. *Ovary* ovoid, tapering into the equally long filiform style. *Fruit pedicel* c. 2 mm long, slender; base of fruit frequently impressed. 2 longer *calyx lobes* to 5.5 by 1.2 cm, spatulate, narrowly obtuse, c. 5 mm broad above the c. 7 mm broad subauriculate centrally saccate thickened base; 3 shorter lobes to 20 by 7 mm, similarly subauriculate, completely enclosing the nut. *Nut* to 10 by 7 mm, ovoid, acute.

Distr. *Malesia*: Malaya (Perak, Selangor, Trengganu, Johore).

Ecol. Locally abundant on ridges, at 100–400 m.

Vern. *Mērawan mēranti*, *pēngēravan bukit*.

**8. *Hopea fluvialis*** ASHTON, Gard. Bull. Sing. 19 (1962) 254, pl. 1; Man. Dipt. Brun. (1964) 100, f. 12; *ibid.* Suppl. (1968) 51. — **Fig. 64c.**

Medium sized, usually leaning, tree with smooth bark. Young parts shortly densely pale grey-brown tomentose, persistent on twig, leaf bud, stipule, panicle and petiole, fugaceous elsewhere. *Twig* to 1.5 mm  $\varnothing$  apically, terete, becoming smooth, glabrous.



Fig. 66. Habit of a 60 m high *Hopea mengerawan* MIQ., *ngarawan*. Palembang (Photogr. THORENAAR, 1923).

*Bud* to 1 mm long, ovoid, obtuse. *Stipule* to 2 mm long, linear, fugaceous. *Leaves* 7–12 by 2.8–4.8 cm, chartaceous to thinly coriaceous, lanceolate to ovate; base narrowly or broadly cuneate; acumen subequal, to 1.5 cm long, caudate; nerves many, c. 10 pairs with

long secondaries, slender, at 60°–80°, arched, the basal pair continuing as intramarginal nerves to  $\frac{1}{3}$  up the margin; tertiaries  $\pm$  reticulate, indistinct; midrib flat or slightly raised beneath, prominently raised above; *petiole* 7–10 mm long. *Panicle* to 6 cm long, axillary, rarely terminal, borne singly or to 3-axillary, terete; regularly singly or doubly branched; branchlets to 1.5 cm long, bearing to 7 flowers; *bracteoles* to 2 mm long, ovate, acuminate, 3 inner lobes thinner, elliptic, mucronate. *Petals* narrowly lanceolate, densely pubescent outside, glabrous within. *Stamens* 15; filaments broad at base, tapering and filiform distally; anthers subglobose, the posterior cells somewhat smaller than the anterior cells; appendage to connective c. 2 times length of anther. *Ovary* ovoid, glabrous; style filiform, tapering, as long as ovary. *Fruit calyx* glabrous, tapering into 7 by 5.5 mm expanded, but unthickened and hardly saccate, base; 3 shorter lobes unequal, 1–2.5 cm long, acute, tapering, cupped and enveloping the nut. *Nut* to 11 by 6 mm, narrowly ovoid, tapering to a short acute style remnant.

Distr. *Malesia*: Borneo (S. E. Borneo, S. E. Sabah, North-East Sarawak and Brunei).

Ecol. Locally abundant on clay rich river banks.

Vern. *Mérawan ayêr*.

9. *Hopea mengerawan* MIQ. Sum. (1860) 492, 192; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7. (1868) 379; SCHEFF. Nat. Tijd. N. I. 1 (1870) 351; HANCE, J. Bot. 14 (1876) 308; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 240, excl. syn. *H. cernua* T. & B.; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 125; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 70, p.p.; BURK. J. Str. Br. R. As. Soc. 81 (1920) 59, fig.; RIDL. Fl. Mal. Pen. 1 (1922) 238; THORENAAR, Med. Proefst. Boschw. 16 (1926) 112; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 1190; ed. 2 (1927) 1107, 1110; FOXW. Mal. For. Rec. 10 (1932) 137; BURK. Dict. (1935) 1190; SYM. Gard. Bull. S. S. 10 (1939) 361; Mal. For. Rec. 16 (1943) 132, f. 69, 73; ASHTON, Man. Dipt. Brun. Suppl. (1968) 53, f. 7. — *Hancea mengerawan* PIERRE, For. Fl. Coch. 3 (1891) sub t. 244. — Fig. 66.

Tall buttressed tree with dark fissured bark. Twigs, petiole and leaf beneath caducous lepidote, parts otherwise glabrous. *Twig* c. 2 mm  $\varnothing$  apically, slender; stipule scars short, pale. *Leaf bud* to 2 by 1 mm, ovoid. *Stipule* fugaceous. *Leaf* 6–12 by 2.5–5 cm, lanceolate, thickly coriaceous; base cuneate; acumen to 1.5 cm long, slender but evident beneath, with many short to subequal secondaries; midrib stout, prominent, on both surfaces; *petiole* 9–11 mm long, relatively short. *Panicle* to 3 cm long, terminal or axillary, terete, singly branched; branchlets bearing to 6 second flowers; *bracteoles* c. 2 mm long, acicular, fugaceous. *Flower* pale yellow; *bud* to 3 by 2 mm, ovoid. *Calyx lobes* ovate, the 2 outer narrower, more coriaceous than the frequently suborbicular 3 inner. *Petals* sericeous on parts exposed in bud; *stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the subglobose anthers; appendage to connective slender, 2–3 times length of anther. *Ovary*



ovoid, glabrous; style *c.* 2 times length of ovary, villous in the basal  $\frac{1}{3}$ . *Fruit pedicel* to 2 mm long, slender. 2 longer *calyx lobes* to 7 by 1.2 cm, narrowly spatulate, narrowly obtuse, *c.* 3 mm broad above the to 7 by 4 mm narrowly ovate saccate thickened base; 3 shorter lobes to 6 by 5 mm, ovate, acute, saccate. *Nut* to 10 by 5 mm, narrowly ovoid; style remnant slender.

**Distr. Malesia:** Malaya (Negri Sembilan, Pahang southwards in east), Singapore, Billiton, Banka, Sumatra (Palembang, Lampong, Riouw, West Coast Res. at Tapanuli), Borneo (Central Sarawak, Melawi, Sampit N.E. to Nunukan).

**Ecol.** Local, on soils with impeded drainage on flat land and the base of hills.

**Use.** The resin was considered one of the best varieties in Sumatra and Malaya.

**Vern.** *Mērawan pēnak*, *m. hitam*, *pēngērawan*, *p. pēnak* (Mal.), *mērawan banglai*, *chēngal*, *c. bulu* (Sumatra), *njērakat*, *ēmang*, *bangkirai tēmbaga*, *b. telor* (S. E. Borneo).

**10. *Hopea micrantha* HOOK. f.** Trans. Linn. Soc. 23 (1860) 161; DC. Prod. 16, 2 (1868) 634; WALP. Ann. 7 (1868) 379; DYER, Fl. Br. Ind. 1 (1874) 310, *p.p.*, *quoad spec. Born.*; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 239; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 70, *p.p.*; MERR. En. Born. (1921) 402, *p.p.*; SYM. Gard. Bull. S. S. 9 (1938) 323–329; *ibid.* 10 (1939) 355, pl. 19; BROWNE, For. Trees Sarawak & Brunei (1955) 121, *p.p.*; ASHTON, Man. Dipt. Brun. (1964) 103, f. 12; *ibid.* Suppl. (1968) 54; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 213. — *Hancea micrantha* PIERRE, For. Fl. Coch. 4 (1891) t. 243.

Small to medium-sized smooth barked tree with small narrow buttresses and abundant stilt roots. Young twig, leaf bud, panicle, petiole, and stipule pale brown fugaceous pubescent. *Twig* to 1.5 mm  $\varnothing$  apically, slender, glabrous apart from the apices, terete, smooth. *Bud* to 2 by 1.5 mm, ovoid, obtuse. *Stipule* to 2 mm long, narrowly deltoid, acute, fugaceous. *Leaves* 6–8 by 2.5–3 cm, oblong-lanceolate, coriaceous; base obtuse or broadly cuneate, equal; acumen to 1.5 cm long, caudate; nerves 10–12 pairs, indistinct, curved, with short secondaries; midrib straight, slightly raised above, prominently so beneath; *petiole* 7–10 mm long, short. *Panicle* to 1 cm long, terminal or axillary, terete; singly branched, branchlets short, bearing up to 5  $\pm$  second flowers; *bracteoles* small, narrowly deltoid, glabrescent, fugaceous. *Bud* small, ovoid. *Calyx* puberulent outside, glabrous within; 2 outer lobes narrowly ovate, acuminate, 3 inner lobes thin, suborbicular, mucronate; *petals* linear, densely pubescent on parts exposed in bud. *Stamens* 15, of 3 lengths; filaments slender, tapering; anthers broadly oblong; appendage to connective *c.*  $1\frac{1}{2}$  times length of anther. *Ovary* ovoid, glabrous, without distinct stylopodium; style *c.*  $1\frac{1}{2}$  times length of ovary, filiform, glabrous. *Fruit calyx* glabrous; 2 longer lobes to 5 by 1.2 cm, spatulate, obtuse, to 2 mm wide above the to 4 by 3 mm saccate deltoid thickened base; 3 shorter lobes to 5 by 5 mm,

broadly ovate to suborbicular, subacute to obtuse, thin, saccate, shorter than the nut. *Nut* to 10 by 6 mm, ovoid; style remnant to 1.5 mm long, filiform.

**Distr. Malesia:** Borneo (northern coast between Limbang and Bintulu, including Labuan).

**Ecol.** Mostly on kerangas and white-sand terraces, or in heath forest, sometimes associated with *Agathis*, rarely on sandy clay soil, or on hillsides, at low altitude.

**Vern.** *Mērawan kērangas*.

**11. *Hopea kerangasensis* ASHTON**, Gard. Bull. Sing. 22 (1967) 277, pl. 22; Man. Dipt. Brun. Suppl. (1968) 52, f. 7.

Medium-sized smooth barked tree with thin flying buttresses. Twigs, petiole, buds, midrib above and domatia beneath shortly evenly persistently pale tawny pubescent, sometimes glabrescent. *Twig* *c.* 1 mm  $\varnothing$  apically, much branched, terete, becoming smooth. *Bud* to 1 mm, minute, globose. *Stipule* fugaceous. *Leaves* 1.5–4.5 by 1–3 cm, small, ovate, chartaceous, with broadly cuneate base; acumen to 1 cm long, caudate; nervation dryobalanoid, obscure, main nerves *c.* 6 pairs; midrib slightly depressed above, slender but prominent beneath, with to 6 pairs of prominent large pale fulvous pubescent domatia; *petiole* 3–5 mm long, slender. *Panicle* to 12 mm long, axillary, small, terete, sparsely buff puberulous; singly branched, branchlets to 4 mm long, bearing to 3 distichous flowers; *bracteoles* minute, linear, fugaceous. *Flower bud* *c.* 1.5 by 1 mm, ovoid. *Sepals* ovate, acuminate, glabrous; the inner 3 shorter, relatively narrower at apex, relatively broader medially, than the outer. *Petals* lanceolate, puberulent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the subglobose anthers; appendage to connective slender, 2–3 times length of anther, reaching almost to style apex at anthesis. *Ovary* ovoid, glabrous; style as long as ovary, columnar, tapering. *Fruit* glabrous. *Pedicel* to 1 mm long, short. *Calyx lobes* to 6 by 5 mm, subequal, ovate, acute, saccate, thickened, the 2 outer shorter, narrower and more incrassate than the 3 inner. *Nut* to 8 by 5 mm, ovoid, subacute.

**Distr. Malesia:** Malaya (Pahang, Trengganu); Sumatra (Indragiri); Borneo (Sarawak west of the Lupar; Central Kalimantan: Upper Barito).

**Ecol.** Very local; there abundant, on leached soil in Mixed Dipterocarp and Heath forests on low hills.

**Vern.** *Sēlangan kērangas* (Sar.).

**12. *Hopea vesquei* HEIM**, Bull. Mens. Soc. Linn. Paris 2 (1891) 971; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 68; MERR. En. Born. (1921) 403; BROWNE, For. Trees Sarawak & Brunei (1955) 122; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 226; ASHTON, Man. Dipt. Brun. Suppl. (1968) 57, f. 7.

Medium-sized tree with patchily cracked bark and thin buttresses. Young twigs, leaf bud, stipule and petiole  $\pm$  caducous grey-brown puberulent. *Twig* *c.* 1



Fig. 67. Stilt-rooted stem-base of *Hopea malibato* FOXW. Basilan, Philippines (Photogr. GUTIERREZ).

mm  $\varnothing$  apically, terete, much branched, straight, smooth; stipule scars short, obscure. *Bud* to 2 by 1 mm, ellipsoid, obtuse. *Stipule* to 3 mm long, linear, caducous. *Leaves* 3.5–6 by 1.5–3.5 cm, broadly ovate, coriaceous; base cuneate to obtuse; acumen to 1 cm long, slender; nervation dryobalanoid, main nerves c. 10–13 pairs, slender, hardly raised, with shorter secondaries; tertiary nerves obscure, reticulate; midrib somewhat raised on both surfaces; *petiole* 6–7 mm long, slender. *Panicle* to 3 cm long,  $\pm$  terete, ribbed, greyish tawny puberulent; singly branched, branchlets to 1 cm long, bearing to 5 flowers; *bracteoles* c. 1 mm long, short, linear, fugaceous. *Flower bud* to 3 by 2 mm, ellipsoid. *Sepals* ovate, pubescent on parts exposed in bud, 3 outer acute, 2 inner relatively broader, narrower at base, mucronate. *Petals* lanceolate, pubescent on parts exposed in bud; *stamens* 15, the inner 5 taller than the rest; filaments broad and compressed at base, tapering and filiform below the subglobose anthers; appendage to connective slender, slightly longer than anther. *Ovary* ovoid, glabrous; style c.  $1\frac{1}{2}$  times length of ovary, columnar. *Fruit* glabrous. *Pedice*l 1–2 mm long, short, slender. *Calyx*

*lobes* sparsely setose in the basal half; 2 longer to 3.4 by 0.8 cm, spatulate, obtuse, c. 2 mm broad above the to 4 by 3 mm narrowly ovate somewhat thickened and saccate base; 3 shorter lobes to 4 by 4 mm, ovate, acute, saccate. *Nut* to 15 by 3 mm; cylindrical, style remnant c. 1 mm long, short.

Distr. *Malesia*: Borneo (W. and N. E. Sarawak).

Ecol. Locally abundant on leached yellow sandy soils in Mixed Dipterocarp forest on coastal hills.

Vern. *Luis tébal*.

**13. *Hopea dryobalanoides*** MIQ. Sum. (1860) 492; DC. Prod. 16, 2 (1868) 634; WALP. Ann. 7 (1868) 379; SCHEFF. Nat. Tijds. N. I. 31 (1870) 351; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 240; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 125, 126; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 69; BOERL. Cat. Hort. Bog. (1901) 104; HEYNE, Nutt. Pl. ed. 2 (1927) 1107; ENDERT, Tectona 28 (1935) 248; RAPPAUD, Tectona 30 (1937) 897; SYM. Gard. Bull. S.S. 10 (1939) 345, pl. 15; Mal. For. Rec. 16 (1943) 123, f. 69; BROWNE, For. Trees Sarawak & Brunei (1955) 120; ASHTON, Gard. Bull. Sing. 20 (1963) 259; Man. Dipt. Brun. (1964) 50, f. 12, pl. 29



(seedlings); *ibid.* Suppl. (1968) 50; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 209. — *Hancea dryobalanoides* PIERRE, For. Fl. Coch. 4 (1891) sub t. 244. — *H. sarawakensis* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 971; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 69; MERR. En. Born. (1921) 403. — *H. borneensis* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 972; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 66, 69; MERR. En. Born. (1921) 402. — *H. micrantha* (non HOOK. f.) KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 126; FOXW. Mal. For. Rec. 10 (1932) 135; MERR. En. Born. (1921) 402, *p.p.* — **Fig. 12, 13, 62b-d.**

Tall tree with flaky bark and prominent thin buttresses and a few stilt roots. Young twig, leaf bud, petiole and leaf beneath shortly densely greyish brown fugaceous pubescent; domatia persistently so. Twig to 1 mm  $\varnothing$  apically, terete, slender, glabrous, smooth. Leaf bud to 1 mm long, minute. *Stipule* to 2 mm long, fugaceous. *Leaves* 5–12 by 1.5–4.5 cm, ovate-lanceolate, thinly coriaceous; base cuneate, equal or subequal; acumen to 2 cm long, narrow, caudate; nerves 8–12 pairs, slender but distinct beneath, curved, with or without scattered axillary domatia; with few short secondaries; midrib slender, raised and frequently sharp on both surfaces, more prominently so beneath; petiole 5–10 mm long, short, slender. *Panicle* to 5 cm long, terminal or axillary, 1–2-axillary, lax, terete, puberulent to glabrous; singly branched, branchlets bearing to 6 flowers; *bracteoles* small, linear. *Bud* small, broadly ovoid. *Calyx* puberulent outside, fimbriate; 2 outer lobes ovate, acuminate; 3 inner lobes suborbicular, shortly mucronate. *Petals* narrowly lanceolate, shortly tomentose on parts exposed in bud, pale yellow. *Stamens* 15, in 3 whorls; filaments slender, tapering; anthers subglobose; appendage to connective c. 2 times length of anther, sometimes sparsely glandular papillose. *Ovary* ovoid, glabrous, without distinct stylopodium; style as long as ovary, setose in the basal half, glabrous distally. *Fruit calyx* glabrous; 2 longer lobes to 6.5 by 1.5 cm, long, spatulate, subacute, pronouncedly twisted, tapering to 5 mm broad above the to 6 by 6 mm deltoid thickened saccate base; 3 shorter lobes to 8 by 6 mm, shorter than the nut, broadly ovate, obtuse or subacute, saccate but thinner than base of outer lobes. *Nut* to 10 by 8 mm, broadly ovoid, glabrous; style remnant to 1.5 mm long, filiform.

Distr. *Malesia*: Malaya, Sumatra, Borneo.

Ecol. Widespread, locally frequent, clay-rich fertile soils on undulating or well drained flat land, or ridges below 600 m; common on basalt and intermediate igneous and volcanic rocks on slopes and ridges.

Uses. Formerly an important producer of damar mata kuching.

Vern. *Mata kuching hitam*, *mĕrawan mata kuching* (Mal.), *damar m.k.*, *bayang gunung*, *sĕluai hitam* (Sum.), *mang bĕsi*, (*emang*) *bĕrjangkar*, *mĕnsĕga* (Indon. Borneo).

**14. *Hopea malibato*** Foxw. in Elmer, Leaf. Philip. Bot. 6 (1913) 1953; Philip. J. Sc. 13 (1918) Bot. 184;

*ibid.* 67 (1938) 281; MERR. En. Philip. 3 (1923) 93; GUTIERREZ, Act. Manil. 4A, 2 (1968) 39, f. 7, pl. 3; ASHTON, Gard. Bull. Sing. 31 (1978) 28. — *H. pierrei* (non HANCE) FOXW. Philip. J. Sc. 6 (1911) Bot. 265, *p.p.*; *ibid.* 13 (1918) Bot. 184, *p.p.* — *H. foxworthyi* (non ELMER) FOXW. Philip. J. Sc. 67 (1938) 282, *p.p.* — *H. woodiana* GUTIERREZ, Act. Manil. 4A, 2 (1968) 42, f. 8, pl. 4 — *H. dalingdingan* GUTIERREZ, Kalikasan 5 (1976) 92, f. 1. — **Fig. 67, 68.**

Medium-sized smooth barked tree. Domatia persistently greyish puberulent; young twigs, petioles and sepals fugaceous so, parts otherwise glabrous. *Twigs* c. 1 mm  $\varnothing$  apically, slender, terete, smooth, dark brown; *stipules* fugaceous. *Buds* minute. *Leaves* 5–9 by 1.5–4 cm, lanceolate-falcate; base cuneate,  $\pm$  shortly decurrent; acumen to 2 cm long, caudate, very slender; nervation dryobalanoid, main nerves c. 11 pairs, ascending, arched, with  $\pm$  shorter secondaries, very slender but evident and elevated beneath,  $\pm$  obscure above, with or without prominent pubescent axillary domatia; tertiary nerves densely reticulate,  $\pm$  obscure; midrib slender but distinctly and  $\pm$  equally elevated on both surfaces; *petiole* 8–16 mm long, slender. *Panicles* to 2.5 cm long, axillary, slender, singly branched; branchlets to 12 mm long, bearing to 5 flowers. *Flower buds* to 6 by 3 mm, ellipsoid. *Sepals* ovate, subacute, fimbriate apically, the inner 3 somewhat broader at base. *Petals* glabrous. *Stamens* 15; filaments lorate, tapering; appendages c. 1½ times as long as the subglobose anthers, shorter than style. *Ovary* ovoid, glabrous, without stylopodium, with columnar style 1½–2 times its length. *Fruit pedicel* to 2 mm long, short, slender; 2 longer calyx lobes to 35 by 9 mm, spatulate, obtuse, to 2 mm wide above the 4 by 3 mm ovate saccate thickened base; 3 shorter lobes to 4 by 4 mm, ovate, subacute, shorter than the to 7 by 4 mm apiculate nut.

Distr. *Malesia*: Philippines.

Ecol. Widespread and locally common in evergreen non-seasonal dipterocarp forests.

Vern. *Malibato*, *barakbakau*, *danginginan* (Mbo.), *dadingdingan* (Tag.), *dala* (Neg.), *dalingdingan* (Bik., Tag., Dum.), *dalingdinganisak* (Tag., Bik.), *isak* (Tag.), *kaliot* (Pang.), *lito* (Ibn.), *malatagum* (Bik.), *manggachapuy* (Bik., Tag., Mbo., Pang.), *mululagum*, *pisak* (Bik.), *pisak* (Ibn.), *sarabsaban* (Mang.), *siyan*, *sugkad* (S.L. Bis.), *yakal-keliot* (official name).

Notes. This species is variable in tree size, leaf size and shape, and flower size and colour. On the basis of these differences GUTIERREZ has recognized two additional species for small-leaved collections formerly confused with *H. pierrei* HANCE and *H. foxworthyi* ELMER. These latter species conspicuously differ in their obscure depressed midribs on the leaf above as well as other characters. Though further study may prove him correct, I do not uphold these as the same level of variation occurs within some other dipterocarp species as here recognized, e.g. *H. dryobalanoides* and also in *Shorea ovata* and *S. curtisii*.

I define *H. malibato* by its dryobalanoid, unequal-based, ovate-lanceolate leaf with c. 11 pairs of slender



Fig. 68. Flowering twig of *Hopea malibato* Foxw. Basilan (Photogr. GUTIERREZ).

but elevated nerves with shorter secondaries, its evident and elevated midrib above, and by the absence of a floral stylopodium, small fruit and glabrous parts except for the petals and more or less caducous puberulent innovations. It differs therefore from *H. vesquei* HEIM in that the ripe nut does not exceed 11 mm length, from *H. dryobalanoides* MIQ. in that the fruit sepals do not exceed 4 cm length (as well as in characters of the leaf midrib and petiole), and from *H. johorensis* SYM., *H. latifolia* SYM. and *H. ferruginea* PARIJS notably in its glabrous panicle.

**15. *Hopea johorensis* SYM.** J. Mal. Br. R. As. Soc. 19, 2 (1941) 139, pl. 1B; Mal. For. Rec. 16 (1943) 130, f. 69.

Medium-sized trees with stilt roots and reddish powdery bark. Panicles and petals outside persistently greyish buff pubescent, twig apices, petioles and calyx outside caducously so. *Twig* c. 1 mm  $\varnothing$ , ribbed along the leaf traces, becoming blackish; stipule scars small, pale. *Leaf bud* minute; *stipule* fugaceous. *Leaves* 3–7 by 1.5–3.5 cm, ovate, coriaceous; base  $\pm$  abruptly cuneate, subequal; acumen to 12 mm long, prominent, slender, caudate; nerves many, main nerves c. 16 pairs with many subequal secondary nerves, very slender and hardly elevated beneath, obscure above; midrib slender but distinctly and equally elevated on both surfaces; *petiole* 7–13 mm long, slender. *Panicle* to 15 mm long, short, axillary, with short branchlets bearing to 3 flowers. *Mature flowers* unknown. *Stamens*

15. *Fruit pedicel* c. 2 mm long, very slender; 2 longer *calyx lobes* to 4 by 0.8 cm, spatulate, subacute, tapering to c. 1 mm wide above the to 3 by 3 mm ovate saccate thickened base; 3 shorter lobes to 3 by 3 mm, ovate, subacuminate. *Nut* to 8 by 4 mm, lanceolate, minutely apiculate.

Distr. *Malesia*: Malaya (E. Johore).

Ecol. Local, on hill ridges.

Vern. *Mata kuching pipit*, *mĕrawan*.

**16. *Hopea latifolia* SYM.** Gard. Bull. S. S. 10 (1939) 360; Mal. For. Rec. 16 (1943) 131, f. 69; ASHTON, Man. Dipt. Brun. (1964) 102, f. 12; *ibid.* Suppl. (1968) 52. — *H. intermedia* (non KING) FOXW. Mal. For. Rec. 10 (1932) 134, p.p. — *H. beccariana* (non BURCK) SYM. Gard. Bull. S. S. 9 (1938) 325, p.p.

Medium-sized smooth barked tree with small thin buttresses and stilt roots. Twig, leaf bud, stipule and leaf as *H. beccariana*. *Panicle* to 4 cm long axillary, rarely terminal, shortly grey-brown pubescent or glabrescent, terete, borne singly; singly or doubly branched, the branchlets bearing up to 5 distichous flowers. *Leaf bud* small, ovoid. *Calyx* shortly pubescent outside, glabrous within; 2 outer lobes ovate, acuminate, 3 inner lobes suborbicular, mucronate, thinner. *Petals* small, ovate, obtuse, pubescent on parts exposed in bud. *Stamens* 15, in 3 whorls; filaments broad at base, tapering somewhat abruptly distally; anthers subglobose; appendage to connective as long as anther, slender. *Ovary* ovoid, glabrous; style as long as ovary, without distinct stylopodium, filiform,  $\pm$  villous towards base. *Fruit calyx* glabrous; 2 longer lobes to 6 by 1.4 cm, spatulate, narrowly obtuse, tapering to 3 mm broad above the to 5 by 4 mm deeply saccate thickened base; 3 shorter lobes to 9 by 7 mm, ovate, acute, saccate, thickened, frequently hiding the nut. *Nut* to 8 by 7 mm, broadly ovoid, style remnant to 2 mm long, filiform.

Distr. *Malesia*: Malaya, Borneo (Sarawak, Brunei).

Ecol. Rare, low lying land in Mixed Dipterocarp forest; once from deep soil over limestone in Perlis.

Vern. *Mĕrawan daun bulat*, *m. jongkang*, *m. batu*, *chĕngal mata kuching* (Mal.).

**17. *Hopea ferruginea* PARIJS** in Fedde, Rep. 33 (1933) 243; Bijdr. O-I. Damarhars (1933) 89; SYM. Gard. Bull. S. S. 10 (1939) 349, pl. 17; Mal. For. Rec. 16 (1943) 125; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 211, f. 27, pl. 23a (stem). — *H. micrantha* (non HOOK. f.) DYER, Fl. Br. Ind. 1 (1874) 310, p.p.; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 124, p.p.; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 70, p.p.; RIDL. Fl. Mal. Pen. 1 (1922) 237, p.p.; FOXW. Mal. For. Rec. 10 (1932) 136, f. 68D, 69; BUCKLEY, Mal. For. Rec. 11 (1932) 21. — *H. myrtifolia* (non MIQ.) HEYNE, Nutt. Pl. ed. 2 (1927) 1107; ENDERT, Tectona 28 (1935) 248. — *H. intermedia* (non KING) FOXW. Mal. For. Rec. 3 (1927) 74, p.p.; *ibid.* 10 (1932) 134, p.p. — *H. pierrei* (non HANCE) FOXW. Mal. For. Rec. 10 (1932) 133, p.p. — **Fig. 63 B1–B4.**



Medium-sized flaky barked tree with stilt roots and flying buttresses. Twig endings, petioles, midrib above and panicles densely  $\pm$  persistently greyish puberulent, petals outside densely cream pubescent. *Twig* c. 1 mm  $\varnothing$  apically, terete, becoming dark brown, smooth; internodes short; stipule scars obscure. *Leaf bud* minute; *stipules* minute, fugaceous. *Leaves* 4.5–7.5 by 1.5–4 cm, ovate to lanceolate, subcoriaceous; base cuneate, shortly decurrent; acumen to 1.5 cm long, slender, caudate; nervation dryobalanoid, main nerves c. 14 pairs with many subequal secondaries, distinct and frequently with  $\pm$  prominent axillary pubescent domatia especially in young trees; midrib slender but distinctly elevated on both surfaces; *petiole* 6–10 mm long, slender. *Panicles* to 2 cm long, axillary, slender, short, with to 8 mm long short branchlets bearing to 4 second pale yellow flowers. *Flower bud* to 3 by 2 mm, ellipsoid. *Sepals* ovate, the 3 outer somewhat longer, acute or subacuminate, the inner acute. *Stamens* 15, unequal; filaments broadly compressed at base, tapering and filiform distally; appendage very slender, c. twice length of the subglobose anthers. *Orary* ovoid, style somewhat longer, columnar, tapering, villous towards base. *Fruit pedicel* to 2 cm long, very slender; 2 longer fruit *calyx lobes* to 3 by 0.5 cm, spatulate, narrowly obtuse, c. 1.5 cm broad above the to 4 by 2.5 mm ovate saccate thickened base; 3 shorter lobes to 8 by 4 mm, ovate-acuminate, closely enveloping nut. *Nut* to 7 by 4 mm, ovoid, apiculate.

Distr. *Malesia*: Malaya (Perak and Pahang southwards), Riouw Arch., E. and Central Sumatra (Tapanuli, Djambi), E. Borneo (Kudat to Pleihari and Martapura); wrongly recorded from Sarawak by BROWNE (Forest Trees of Sarawak and Brunei, 1955, 21).

Ecol. Deep fertile soils in Mixed Dipterocarp forest below 750 m; locally frequent.

Uses. A minor source of damar mata kucing.

Vern. *Mata kucing mērah*, *mērawan m.k.*, *mērawan jangkang*, *m. mērah*, *m. pasir* (Malaya), *gangsal* (Djambi), *mēranti emeh* (Tapanuli), *mērawan puteh* (Kalimantan), *sēlangan mata kucing* (Sabah).

**18. *Hopea pierrei*** HANCE, J. Bot. 15 (1876) 308; *ibid.* 16 (1877) 329; BRANDIS & GILG in E. & P. Fl. Fam. ed. 1, 3, 6 (1894) 263; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 67, *p.p.*; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 372; GILG in E. & P. Fl. Fam. ed. 2, 21 (1925) 238; DAKKUS, Bull. Jard. Bot. Btzg III, Suppl. 1 (1930) 162; SYM. Gard. Bull. S. S. 9 (1938) 323, pl. 17; Mal. For. Rec. 16 (1943) 139, f. 69; SMITINAND, Thai For. Bull. 1 (1954) 19; ASHTON, Gard. Bull. Sing. 31 (1978) 29. — *H. micrantha* (non HOOK. f.) HANCE, J. Bot. 15 (1876) 242. — *Hancea pierrei* PIERRE, For. Fl. Coch. 4 (1891) t. 248. — *H. avellanea* HEIM, Bot. Tidsskr. 25 (1902) 46; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 375; CRAIB, Fl. Siam. Enum. 1 (1925) 147; SMITINAND, Thai For. Bull. 1 (1954) 10; Nat. Hist. Bull. Siam Soc. 19 (1958) 63.

Medium-sized smooth barked tree, with thin but-

resses and sometimes stilt roots. Twig apex fugaceous puberulent, ovary caducously so, petals outside densely cream pubescent, parts otherwise glabrous. *Twig* c. 1 mm  $\varnothing$  apically, very slender, straight, terete, horizontal, dark brown; stipule scars obscure. *Leaf bud* minute; *stipules* minute, linear, fugaceous. *Leaves* 4–8 by 1.6–4 cm, lanceolate, subcoriaceous; base abruptly broadly cuneate; acumen to 12 mm long, slender, caudate; nervation dryobalanoid, main nerves c. 18 pairs with many  $\pm$  equal secondaries, very slender and hardly evident beneath, obscure above; midrib slender but prominent, terete beneath, obscurely depressed above; *petiole* 6–11 mm long, slender. *Panicle* to 2 cm long, slender, axillary or sometimes terminal, singly branched; branchlets to 8 mm long, bearing to 4 pale yellow flowers. *Buds* to 3 by 2 mm. *Sepals* broadly ovate, acute to subacuminate. *Stamens* 15, compressed at base, tapering; appendages very slender, c.  $3 \times$  length of the subglobose anthers. *Ovary* and *stylopodium* hour-glass-shaped, equal, punctate beneath the short tapering style, with prominent median constriction. *Fruit pedicel* to 2 mm long, very slender. 2 longer *calyx lobes* to 27 by 7 mm, small, spatulate, obtuse, c. 1 mm broad above the to 3 by 2 mm ovate saccate thickened base; 3 shorter lobes to 3 by 2 mm, ovate. *Nut* to 6 by 5 mm, ovoid, shortly apiculate.

Distr. Vietnam, Cambodia, S.E. Thailand, and in *Malesia*: Malaya (Pahang, Selangor, Negri Sembilan).

Ecol. Ridges at 300–700 m in Malaya, sometimes locally gregarious (abundant in Heath forest in Cambodia, and widespread on sandy soils in evergreen forest in Indochina).

Vern. *Mērawan palong*.

**19. *Hopea inexpectata*** ASHTON, Gard. Bull. Sing. 31 (1978) 29.

Medium-sized smooth barked tree. Young twigs, petioles and base of peduncle caducous tawny puberulent. *Twigs* c. 2 mm  $\varnothing$  apically, slender, much branched, somewhat ribbed, becoming blackish, smooth. *Leaves* 5–9 by 2.4–4.5 cm, ovate, coriaceous; margin subrevolute; base  $\pm$  equal, broadly cuneate; acumen to 15 mm long, slender; nervation dryobalanoid, main nerves 8–10 pairs, slender but distinct elevated beneath, arched, with 1 or a few shorter less distinct secondary nerves; tertiary nerves reticulate, evident beneath; midrib sharply prominent beneath, depressed and obscure above; *petiole* 6–7 mm long, short, slender. *Flowers* unknown. *Panicle* to 2.5 cm long, terminal or axillary to ramiflorous, slender, singly branched; *bracts* unknown, caducous. *Fruit pedicel* to 2 mm long, slender. 2 longer *calyx lobes* to 7 by 1.5 cm, spatulate, subacute, tapering to 2 mm broad above the 4 by 2 mm ovate saccate thickened base; 3 shorter lobes to 6 by 3 mm, ovate, acuminate, shorter than nut; *nut* to 8 by 4 mm, ovoid-acuminate, tapering to a short apiculus bearing the vestiges of a distinct stylopodium.

Distr. *Malesia*: West New Guinea (Keban valley).



Fig. 69. Trunk-base of *Hopea beccariana* BURCK. Brunei, Andalau For. Res. (Photogr. G.H.S. WOOD, SAN 17534).

Ecol. Locally frequent in lowland forest.

Vern. *Bu-aan*, *arais*.

Notes. This unexpected record of the first member of sect. *Dryobalanoides* east of Wallace's Line suggests the possibility of polyphyletic origin, presumably from sect. *Hopea*, which is otherwise the only section occurring in New Guinea and already shows remarkable plasticity there, as in *H. celtidifolia*.

*H. inexpectata* shows a strong superficial resemblance to *H. griffithii* KURZ, but differs in its lustrous leaf undersurface, sericeous young parts and short petiole; flowers are required for critical comparison of androecium and gynoecium.

**20. *Hopea griffithii* KURZ**, J. R. As. Soc. Beng. Sc. 42, 2 (1873) 60; Fl. Burma 1 (1877) 122; DYER, Fl. Br. Ind. 1 (1874) 310; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 69 (*var. pedicellata* excl.); Indian Trees (1906) 68; HEYNE, Nutt. Pl. ed. 2 (1927) 1107; SYM. Gard. Bull. S. S. 9 (1938) 324, 329; *ibid.* 10 (1939) 343, pl. 14; Mal. For. Rec. 16 (1943) 127, f. 69; ASHTON, Man. Dipt. Brun. Suppl. (1968) 51, f. 7. — *Hancea griffithii* PIERRE, For. Fl. Coch. 4 (1891) *sub t.* 248. — *H. pierrei* (non HANCE) RIDL. Fl. Mal. Pen. 1 (1922) 238, *p.p.*

Medium sized smooth-barked tree with thin buttresses and a few stilt roots. Parts glabrous but for the

petals. *Twig* 1 mm  $\varnothing$  apically, terete, slender, much branched. *Bud* to 1 by 1 mm, small, conical. *Stipule* to 2 mm long, linear, fugaceous. *Leaves* 4–9 by 1.7–4.5 cm, ovate to lanceolate, coriaceous; base narrowly or broadly cuneate; acumen to 1.5 cm long, caudate; margin frequently subrevolute; nerves *c.* 9 pairs, dryobalanoid, hardly raised beneath; tertiary nerves reticulate; midrib depressed above, prominent beneath; *petiole* 8–15 mm long, slender. *Panicle* to 2.5 cm long, terminal or axillary, ribbed, glabrous, singly branched; branchlets short, bearing to 5 second flowers; bracteoles to 2 mm long, linear, fugaceous. *Flower bud* to 2 mm long, ellipsoid. *Sepals* broadly ovate, subacuminate, fimbriate, otherwise glabrous, subequal; the inner 3 narrower at base, thinner at margin, than the outer 2. *Petals* lanceolate, erose, densely pubescent on parts exposed in bud, dark red. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the broadly ellipsoid anthers; appendage to connective *c.* 2 times length of anther, slender. *Ovary* and *stylopodium* stoutly pyriform, papillose towards apex, otherwise glabrous, tapering somewhat abruptly below the shortly columnar glabrous style. *Fruit* glabrous. *Pedicel* *c.* 1 mm long, slender. 2 longer *calyx lobes* to 3 by 0.5 cm, spatulate, obtuse. *c.* 2 mm wide above the to 4 by 3 mm deltoid thickened saccate base; 3 shorter lobes to 8 by 1 mm, linear, similarly expanded at base. *Nut* to 7 by 5 mm, ovoid, with to 1 mm long, slender apiculus.

Distr. Lower Burma, and in Malesia: Malaya (E. coast, W. Johore), Borneo (Sarawak W. of the Lupar, ? Rejang hinterland; W. & S. Kalimantan).

Ecol. Leached soils in Mixed Dipterocarp forest on low hills, locally common.

Vern. *Mērawan jantan*, *pērawan*, *pēngērawan bunga* (Mal.).

**21. *Hopea treubii* HEIM**, Bull. Mens. Soc. Linn. Paris 2 (1891) 955; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 68; MERR. En. Born. (1921) 403; ASHTON, Man. Dipt. Brun. (1964) 111, f. 12, pl. 30 (bark); *ibid.* Suppl. (1968) 57. — **Fig. 70 B–B3.**

Medium-sized, fissure-barked tree with low buttresses and flying buttresses. Glabrous but for petals and stylopodium. *Twig* to 1.5 mm  $\varnothing$  apically, slender, terete, smooth. *Bud* to 2 mm long. *Stipule* to 8 mm long, linear, fugaceous. *Leaves* 5–8 by 3–5.5 cm, broadly elliptic to obovate, coriaceous, base cuneate; acumen to 5 mm long, short, broad; margin subrevolute; nerves *c.* 7 pairs, strongly curved, dryobalanoid, at 60°–70° with secondaries running almost to margin; tertiary nerves reticulate, indistinct; midrib broad, rounded, slightly raised on both surfaces; *petiole* *c.* 1 cm long, short. *Panicle* to 8 cm long, terminal or axillary to ramiflorous, to 2-axillary, slender, rigid, strongly ascending, terete or  $\pm$  compressed, glabrous; regularly singly branched, branchlets to 2.5 cm long, straight, bearing to 7 second flowers; bracteoles to 1 mm long, narrowly deltoid, glabrous, fugaceous. *Flower bud* to 2.5 mm long, ellipsoid, on to 2.5 mm



long pedicel. *Calyx* glabrous but for the fimbriate margin; outer lobes ovate-acuminate, inner lobes shorter, thinner, broadly ovate-mucronate. *Petals* narrowly lanceolate, acute, fimbriate, shortly pubescent on parts exposed in bud, lemon yellow. *Stamens* 10, subequal, in a single row; filaments slender, tapering from the base; anthers broadly oblong, subequal; appendage to connective about twice length of anther. *Ovary* and *stylopodium* cylindrical, glabrous but for the glandular papillose apex, subtruncate; style short, abrupt, glabrous. *Fruit pedicel* to 3 mm long, slender. *Calyx* glabrous; 2 longer lobes to 3.5 by 0.7 cm, spatulate, obtuse, to 2 mm broad at the narrow saccate unexpanded base; 3 shorter lobes to 8 by 2 mm, similar at base. Nut to 11 by 5 mm, narrowly ovoid, glabrous; style remnant short, acute.

Distr. *Malesia*: Borneo (Sarawak and Brunei).

Ecol. Local, on deep yellow sandy soils in Mixed Dipterocarp forest on coastal hills.

Vern. *Mĕrawan daun tĕbal*.

**22. *Hopea beccariana*** BURCK, Ann. Jard. Bot. Btżg 6 (1887) 240; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 68; MERR. En. Born. (1921) 401; SYM. Gard. Bull. S. S. 8 (1934) 28, pl. 18; *ibid.* 9 (1938) 325, *p.p.*; Mal. For. Rec. 16 (1943) 122, f. 69, 71; SMITNAND, Thai For. Bull. 1 (1954) 19; BROWNE, For. Trees Sarawak & Brunei (1955) 120; ASHTON, Man. Dipt. Brun. (1964) 95, f. 12, pl. 26 (stem); *ibid.* Suppl. (1968) 48; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 207, f. 26, pl. 22. — *Hancea beccariana* PIERRE, For. Fl. Coch. 4 (1891) *sub t.* 244, in tab. also partly (by error) '*beccarii*'. — *H. nicholsoni* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 973. — *H. intermedia* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 126, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 67, *p.p.*; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 156, t. 189, *p.p.*; HEYNE, Nutt. Pl. ed. 2 (1927) 1107; FOXW. Mal. For. Rec. 10 (1932) 134; DURANT, Rep. For. Brunei (1932) 40; BURK. Dict. (1935) 1190. — *Balanocarpus ovalifolius* RIDL. J. Fed. Mal. Str. Mus. 10 (1920) 130, *p.p.*; Fl. Mal. Pen. 1 (1922) 247, *p.p.*; FOXW. Mal. For. Rec. 10 (1932) 143, *p.p.* — *H. pierrei* (non HANCE) RIDL. Fl. Mal. Pen. 1 (1922) 238, *p.p.* — **Fig. 62a, 63 C1–C4, 64b, 69.**

Large, smooth or fissure-barked buttressed tree. Young twig, bud and petiole waxy glaucescent. *Twig* to 1 mm  $\varnothing$  apically, slender, terete, smooth. *Bud* to 2 by 1 mm, ovoid. *Stipule* to 2.5 mm long, linear, fugaceous. *Leaves* 5–8 by 2.2–4.5 cm, ovate, thinly coriaceous; base cuneate, frequently subequal; acumen to 1.5 cm long, caudate; margin not revolute; nerves *c.* 8 pairs, indistinct, dryobalanoid; main secondaries almost reaching margin; tertiary nerves reticulate, indistinct; midrib slender, slightly raised on both surfaces; *petiole* 1.2–1.7 cm long, slender. *Panicle* to 7 cm long, axillary (rarely terminal), terete, puberulent or glabrous; singly branched, branchlets bearing to 5 second cream flowers; *bracteoles* small, linear, fugaceous. *Flower bud* small, ellipsoid. *Calyx* shortly pubescent outside, glabrous within; 2 outer lobes

ovate-acuminate, 3 inner lobes ovate to suborbicular, obtuse or subacute. *Petals* linear, densely pubescent on parts exposed in bud. *Stamens* 15; filaments slender, tapering; anthers broadly oblong; appendage to connective about twice as long as anther, slender. *Ovary* and *stylopodium* hour-glass-shaped, puberulent towards the apex, tapering into the short glabrous style. *Fruit calyx* glabrous; 2 longer lobes to 3.5 by 1 cm, obtuse, to 2 mm broad above to 4 by 3.5 mm ovate saccate slightly thickened base, twisted; 3 shorter lobes to 7 mm long, acute, similar at base. *Nut* to 9 by 5 mm, broadly ovoid, glabrous; style remnant to 1 mm long.

Distr. Peninsular Thailand (Pattani) and in *Malesia*: Malaya, E. Sumatra (Karimun), Borneo.

Ecol. Widespread, on coastal hills and on deep soils on inland ridges (especially in Malaya), occasionally to 1200 m.

Vern. *Mĕrawan batu*, *m. jangkang*, *m. pĕnak* (Mal.), *sĕlangan pĕnak* (Sab.), *s. hijau*, *garang buaya daun kĕchil* (Brun.), *chĕngai pasir* (Iban), *tĕmang bĕsi*, *bangkirai*, *nuas njĕrakat hitam*, *bĕlang kĕmai* (S.E. Borneo).

**23. *Hopea dyeri*** HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 972; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 68; MERR. En. Born. (1921) 402, *p.p.*; SYM. Gard. Bull. S. S. 8 (1932) 53; *ibid.* 9 (1938) 323, 324; *ibid.* 10 (1939) 353; Mal. For. Rec. 16 (1943) 124, f. 68F, 69; BROWNE, For. Trees Sarawak & Brunei (1955) 120; ASHTON, Man. Dipt. Brun. (1964) 99, f. 12, pl. 28 (stem-base); *ibid.* Suppl. (1968) 50; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 210. — *H. micrantha* (non HOOK. f.) BURCK, Ann. Jard. Bot. Btżg 6 (1887) 239, *p.p.*; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 124, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 70; BURK. J. Str. Br. R. As. Soc. 81 (1920) 58; HEYNE, Nutt. Pl. ed. 2 (1927) 1107; BURK. Dict. (1935) 1190. — *Hancea microptera* PIERRE, For. Fl. Coch. 4 (1891) *sub t.* 244, *nomen*. — *H. microptera* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 68, *nomen in syn.* — *H. intermedia* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 126, *p.p.*; Ann. R. Bot. Gard. Calc. 5, 2 (1896) 156, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 67, *p.p.*; FOXW. Mal. For. Rec. 10 (1932) 134, *p.p.* — *H. pierrei* (non HANCE) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 67, t. 2, f. 10, *p.p.*; MERR. En. Born. (1921) 403, *p.p.*; RIDL. Fl. Mal. Pen. 1 (1922) 238, *p.p.*; FOXW. Mal. For. Rec. 10 (1932) 133, *p.p.* — **Fig. 63 D3–D4.**

Medium-sized tree with flaking bark and thin low buttresses and stilt roots. Bud, stipule, panicle and domatia persistently grey-brown pubescent, twig and petiole caducously so. *Twig* to 1 mm  $\varnothing$  apically, slender, terete, much branched, becoming smooth. *Bud* minute, ovoid, obtuse. *Stipule* to 1.5 mm long, linear, caducous. *Leaves* 2.7–7 by 1.2–2.5 cm, ovate-lanceolate, somewhat coriaceous, frequently lepidote beneath; base cuneate, subequal; acumen to 1.5 cm long, narrow, caudate; margin frequently slightly revolute; nerves 8–12 pairs, slender, slightly raised, distinct beneath with many distinct secondaries fre-

quently subequal to them; midrib stout, raised on both surfaces, more prominently raised above than beneath; *petiole* 5–8 mm long, short, slender. *Panicle* to 3 cm long, terminal or axillary, borne singly, terete; singly or doubly irregularly branched, the branchlets short, bearing to 4 flowers; *bracteoles* minute, oblong, obtuse, pubescent, fugaceous. *Flower* cream; bud small, ovoid, *Calyx* puberulent to glabrous outside, glabrous within; 2 outer lobes narrowly ovate, subacuminate; 3 inner lobes thin, suborbicular, mucronate. *Petals* narrowly lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 whorls; filaments broad at base, tapering; anthers subglobose; appendage to connective about twice length of anther. *Ovary* and *stylopodium* pyriform, glabrous but for the puberulent apex, crowned by a short glabrous style. *Fruit calyx* glabrous; 2 longer lobes to 2.5 by 1 cm, small, spatulate, narrowly obtuse, to 2.5 mm broad above the to 5 by 3 mm narrowly deltoid slightly thickened saccate base; 2 shorter lobes to 7 by 4 mm, ovate, glabrous, acuminate, acute, thin. *Nut* to 9 by 4 mm, narrow, ovoid; style remnant short, acute.

Distr. *Malesia*: Malaya, Borneo (Sarawak, Sabah).

Ecol. Well drained soils on low hills and ridges to 1000 m; locally abundant.

Vern. *Mérawan palit*, *m. hitam*, *péngawan pasir* (Mal.), *sélangan palit* (Sab.), *émang besi* (Kapuas).

**24. *Hopea myrtifolia*** MIQ. Sum. (1860) 49, 192; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7 (1868) 379; SCHEFF. Nat. Tijd. N. I. 31 (1870) 551; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 242; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 71, *p.p.*; MERR. En. Born. (1921) 403, *p.p.*; HEYNE, Nutt. Pl. ed. 2 (1927) 1107; SYM. Gard. Bull. S. 10 (1939) 347, pl. 16; Mal. For. Rec. 16 (1943) 134, f. 69, 74. — **Fig. 63 A–A4.**

Medium-sized, sometimes large, smooth barked tree with stilt roots and thin buttresses. Twigs, leaf buds, petioles, midrib above, and domatia densely ± persistently tawny puberulent, panicles sparsely so, petals outside densely golden pubescent. *Twig* c. 1 mm  $\varnothing$  apically, slender, straight, ± horizontal, terete, becoming dark brown; stipule scars minute, pale. *Buds* minute; *stipules* small, linear, fugaceous. *Leaves* (4.5–)6–12 by (1.8–)2.2–5 cm, lanceolate, coriaceous; base broadly cuneate, subequal; acuminate to 1.8 cm long, prominent; nervation dryobalanoid; main nerves c. 13 pairs, with many ± shorter secondaries, slender but evident beneath, distinctly narrowly depressed above, frequently with pubescent axillary domatia; tertiary nerves usually evident on both surfaces, minutely reticulate; midrib slender but distinctly elevated on both surfaces; *petiole* 6–12 mm long, slender. *Panicle* to 4 cm long, slender, axillary to ramiflorous, singly branched; branchlets to 1.5 cm long, bearing to 7 second flowers. *Flower buds* c. 2.5 by 2 mm, ovoid. *Sepals* broadly ovate to suborbicular, mucronate or subacuminate. *Stamens* 15, filaments broadly compressed at base, tapering and filiform distally; appendages slender, c. twice as long as

subglobose anthers; *ovary* and *stylopodium* narrowly subcylindrical, equal in height but the ovary broader, without median constriction; style shorter than either, columnar, tapering. *Fruit pedicel* to 2 mm long, slender. 2 longer *fruit calyx lobes* to 5.5 by 1.2 cm, spatulate, narrowly obtuse, tapering to c. 2 mm broad above the to 7 by 3 mm ovate saccate thickened base; 3 shorter lobes to 4 by 3 mm, ovate, saccate, thickened. *Nut* to 9 by 7 mm, ovoid, bluntly apiculate.

Distr. *Malesia*: Malaya (S. Perak and Pahang southwards), Karimun, S. Sumatra (Lampung), S.E. Borneo (Pulau Laut, Muara Tewe to Balikpapan and Tarakan), W. Borneo (Melawi).

Ecol. Well-drained undulating land with deep fertile soil.

Vern. *Mata kucing bēludu*, *mérawan jangkang* (Malaya), *mata kucing* (Sumatra), *njérakat jangkang* (Kutei), *bangkirai batu*, *lampēngwea* (Muaratewe).

**25. *Hopea pedicellata*** (BRANDIS) SYM. Gard. Bull. S. 9 (1938) 327, pl. 19; Mal. For. Rec. 16 (1943) 138, f. 68E, 69; SMITINAND, Thai For. Bull. 1 (1954) 10, 19; ASHTON, Man. Dipt. Brun. Suppl. (1968) 54, f. 7; Gard. Bull. Sing. 31 (1978) 30. — *H. micrantha* (non HOOK. f.) KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 124, *p.p.*; RIDL. Fl. Mal. Pen. 1 (1922) 237, *p.p.* — *H. griffithii* var. *pedicellata* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 69, *p.p.* *quoad specim. Malay.*; RIDL. Fl. Mal. Pen. 1 (1922) 238. — *H. intermedia* (non KING) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 67, *p.p.* — *H. mengerawan* (non MIQ.) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 70, *p.p.* — *H. pierrei* (non HANCE) RIDL. Fl. Mal. Pen. 1 (1922) 238, *p.p.*; FOXW. Mal. For. Rec. 10 (1932) 133, *p.p.*; BURK. Dict. (1935) 1193, *p.p.* — *H. siamensis* HEIM, Bot. Tidsskr. 25 (1902) 46; WILLIAMS, Bull. Herb. Boiss. 2, 5 (1905) 147; SCHMIDT, Bot. Tidsskr. 7 (1907) 46; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 376; CRAIB, Fl. Siam. Enum. 1 (1925) 147; SMITINAND, Nat. Hist. Bull. Siam Soc. 19 (1958) 63.

Medium-sized tree with flaky bark, thin buttresses and sometimes a few stilt roots. Young twig and domatia grey-brown puberulent, glabrescent; petiole, leaf bud and stipule persistently so. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched, terete, smooth; stipule scars short, obscure. *Bud* to 1 by 1 mm, ellipsoid, obtuse, minute. *Stipule* small, linear, fugaceous. *Leaves* 4–9 by 1–3.5 cm, ovate-lanceolate, base cuneate; acuminate to 1.5 cm long, subcaudate, slender; nervation dryobalanoid, main nerves c. 8–12 pairs, with subequal secondaries, indistinct, slender, hardly raised; midrib raised on both surfaces; *petiole* 6–8 mm long. *Panicle* to 2 cm long, terminal or axillary, terete, caducous puberulent; singly branched. *Calyx* glabrous, 2 outer lobes ovate, acute, 3 inner suborbicular, mucronate. *Petals* sericeous on parts exposed in bud, pale yellow. *Stamens* 15, unequal; filaments compressed at base, tapering abruptly medially and filiform below the oblong anthers; appendage to connective filiform, c. twice length of anthers. *Ovary* with *stylopodium*, cylindric-conical, attenuate, truncate, punctate in the distal  $\frac{1}{2}$ , surmounted by a short



style. Fruit glabrous. *Pedice* *c.* 2 mm long. 2 longer *calyx lobes* to 3 by 0.5 cm, spatulate, *c.* 2 mm broad above the *c.* 5 by 3 mm ovate saccate thickened base; 3 shorter lobes to 3 by 3 mm, ovate, saccate, adpressed to the nut. *Nut* to 6 by 4 mm, ovoid, abruptly acute.

Distr. Southern Indo-China, Peninsular Thailand and in *Malesia*: Malaya (Trengganu and Perak and northwards), Borneo (Sarawak, Sabah, Nunukan).

Ecol. Rare, in hill forests to 750 m.

Uses. A minor source of damar mata kuching.

Vern. *Mata kuching bukit* (Mal.).

**26. *Hopea altocollina*** ASHTON, Gard. Bull. Sing. 22 (1967) 271, pl. 16, 348 (phot. habit); Man. Dipt. Brun. Suppl. (1968) 46, f. 6, pl. 10 (stem-base).

Tall tree with prominent thin buttresses and pale thinly flaking bark. Sepals and petals sericeous outside; parts otherwise glabrous. *Twigs* *c.* 2 mm  $\varnothing$  apically, terete; stipule scars short, obscure. *Bud* to 1 by 1 mm, subglobose, small. *Stipule* unknown. *Leaves* 7–10 by 3–4.5 cm, lanceolate; base obtuse, appearing cuneate owing to the prominently revolute margin;

acumen to 1 cm long, caudate; nervation dryobalanoid, nerves *c.* 16 pairs,  $\pm$  obscure, with short secondaries; midrib slender, slightly elevated on both surfaces; *petiole* 10–13 mm long, somewhat thickened distally and geniculate, slender. *Panicle* to 8 cm long, terminal or axillary, frequently 2-axillary, terete, glabrous, singly branched. *Flower bud* to 4 by 3 mm. *Sepals* broadly ovate, acute, the inner 3 broader and thinner. *Stamens* 15; filaments rather slender, lorate at base, tapering medially; anthers ellipsoid; appendages *c.* 2  $\times$  length of anthers, very slender. *Ovary* and *stylopodium* cylindrical, punctate at the rounded apex; style short. Fruit entirely glabrous. *Pedice* to 2 mm long. 2 longer *calyx lobes* to 4.5 by 0.8 cm, spatulate, obtuse, 2–3 mm broad above the 6 by 3 mm narrowly ovate thickened saccate base; 3 shorter lobes to 4 by 4 mm, suborbicular, obtuse, shorter than nut. *Nut* to 7 by 5 mm, ovoid; style remnant to 2 mm long, slender.

Distr. *Malesia*: Borneo (Rejang hinterland, Sarawak to Crocker range, S.W. Sabah).

Ecol. Locally frequent, clay rich soils, hillsides and spurs, 800–1000 m.

### *lb. Subsection Sphaerocarpace*

(HEIM) ASHTON, Gard. Bull. Sing. 20 (1963) 258; Man. Dipt. Brun. (1964) 90; GUTIERREZ, Act. Manil. 4, A. 2 (1968) 26. — *Balanocarpus* sect. *Sphaerocarpace* HEIM, Rech. Dipt. (1892) 77. — *Hopea, Bracteata* group SYM. Gard. Bull. Sing. 10 (1939) 338; Mal. For. Rec. 10 (1943) 108.

Leaf nervation subdryobalanoid (except *spp.* 27–30 with scalariform venation); bracts subpersistent; panicles irregularly branched, with long branchlets and few flowers (*H. nervosa*, *H. subalanceolata* excl.); corolla dark coloured; ovary and stylopodium truncate. Small or occasionally medium-sized trees; bark smooth or rarely irregularly cracked; buttresses thin small; usually with stilt roots.

Distr. *Malesia*: Malaya, Sumatra, Borneo, Mindanao.

**27. *Hopea aequalis*** ASHTON, Gard. Bull. Sing. 22 (1967) 271, pl. 15; Man. Dipt. Brun. Suppl. (1968) 46, f. 6. — *H. nov. spec. aff. H. pachycarpa* (non SYM.) MEIJER & WOOD, Sabah For. Rec. 5 (1964) 229.

Small to medium-sized tree. Apparently glabrous apart from the puberulent midrib above. *Twig* *c.* 2 mm  $\varnothing$  apically, terete, smooth; stipule scars short, horizontal, obscure. *Bud* *c.* 2 by 1 mm ellipsoid, obtuse. *Stipule* unknown. *Leaves* 13–25 by 5.5–8 cm, lanceolate, chartaceous; base obtuse; acumen to 1 cm long; nerves 16–20 pairs, slender, elevated beneath, at 65°–70°; tertiary nerves densely scalariform, very slender, diagonal to the nerves; midrib shallowly depressed above, prominent beneath, slender; *petiole* 15–18 mm long. *Flower* unknown. *Panicle* to 9 cm long, axillary, terete, glabrous, unbranched or singly branched. *Fruit* glabrous. *Calyx lobes* to 18 by 16 mm, subequal, ovate, subacute, saccate, incrassate. *Nut* to 23 by 15 mm, ovoid, acute, frequently coated with resin.

Distr. *Malesia*: Borneo (Central Sarawak, Sandakan Distr.).

Ecol. Rare, low hills in Mixed Dipterocarp forest.

**28. *Hopea rudiformis*** ASHTON, Gard. Bull. Sing. 31 (1978) 30.

Medium-sized tree. Twigs, leaf buds and parts of petals exposed in bud densely  $\pm$  persistently pale tawny puberulent; panicles sparsely so; calyx outside and nerves and midrib beneath sparsely caducously so. *Twigs* *c.* 2 mm  $\varnothing$  apically, rather straight, ribbed, becoming smooth, dark brown. *Bud* small, ovoid, acute; *stipules* fugaceous, unknown. *Leaves* 6.5–14 by 3.5–7.5 cm, ovate to broadly lanceolate, thinly coriaceous, minutely stellate lepidote and appearing pale and dull beneath; margin subrevolute; base broadly cuneate; acumen to 1.5 cm long, broad, tapering, down curved and twisted over on pressing; nerves 11–13 pairs, slender but prominent beneath,  $\pm$  obscurely depressed above, arched, at 55°–65°; second-

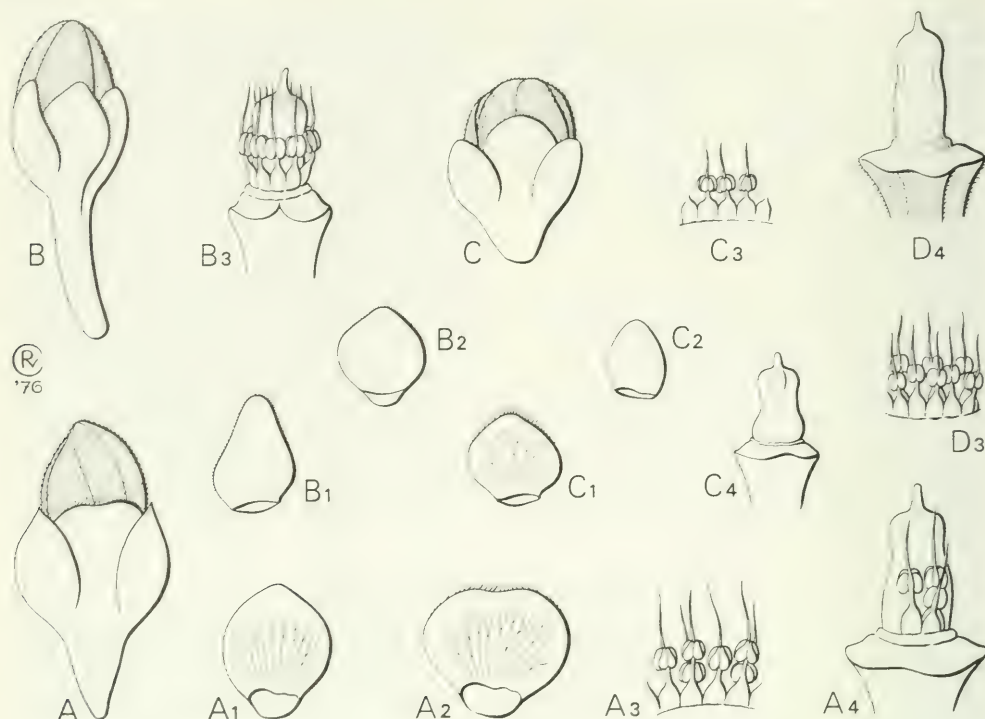


Fig. 70. Flower details in *Heopea* sect. *Dryobalanoides* MIQ. All  $\times 10$ . Sepals drawn from inside. — *H. bracteata* BURCK. A. Bud, A1. outer sepal, A2. inner sepal, A3. stamens from inside, A4. stamens and pistil. — *H. treubii* HEIM. B. Bud, B1. outer sepal, B2. inner sepal, B3. stamens and pistil. — *H. vacciniifolia* RIDL. ex ASHTON. C. Bud, C1. outer sepal, C2. inner sepal, C3. stamens from inside, C4. pistil. — *H. nervosa* KING. D3. Stamens from outside, D4. pistil (A HAVILAND 2225, B ANDERSON S 9482, C HOSE 583, D KOSTERMANS 13981).

ary nerves few, short, hardly elevated beneath; tertiary nerves densely scalariform, obscure; *petiole* 8–13 mm long. *Panicle* to 3.5 cm long, to 2-axillary; singly branched, branchlets bearing to 3 flowers; *bracts* unknown, fugaceous. *Flower bud* to 3 by 2 mm, ovoid, small. *Sepals* subequal, broadly ovate, subacuminate. *Stamens* 15, in 3 subequal verticels; filaments compressed at base, tapering medially and filiform below the shortly oblong anthers; appendages slightly longer than anthers, short, slender. *Ovary* ovoid, surmounted by an indistinct tapering ciliate stylopodium, and short columnar style  $c. \frac{1}{2}$  length of ovary and stylopodium. *Fruit pedicel* to 2 mm long, short, base of ripe fruit  $\pm$  impressed. 2 longer *calyx lobes* to 9 by 2 cm, broadly spatulate, obtuse,  $c. 3$  mm broad above the to 6 by 5 mm ovate deeply saccate thickened base; 3 shorter lobes to 8 by 8 mm, ovate, chartaceous at margin, subacute, reaching apex of nut and adpressed to it; *nut* to 8 by 8 mm, ovoid, terminating in the persistently truncate stylopodium.

Distr. *Malesia*: S.E. Borneo (Tawau to Pulau Laut); Ulu Kapuas, W. Borneo.

Ecol. Undulating land on deep well drained soil in lowlands; sometimes in freshwater swamps.

Vern. *Sēlangan jangkang*, *ēmang bahau*, *putang lēman*, *damar jangkang*.

29. *Heopea nervosa* KING, J. R. As. Soc. Beng. Soc. 62, 2 (1893) 124; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 62; RIDL. Fl. Mal. Pen. 1 (1922) 236; FOXW. Mal. For. Rec. 10 (1932) 129, pl. 10 (hab.), p.p.; BURK. Dict. (1935) 1191; SYM. Mal. For. Rec. 16 (1943) 135, f. 69, 75; ASHTON, Man. Dipt. Brun. (1964) 104, f. 12; *ibid.* Suppl. (1968) 54; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 215, f. 28, pl. 23b (stem). — Fig. 70 D3–D4, 71.

Medium-sized tree. Twig, leaf bud, stipule, panicle, petiole and midrib on both surfaces puberulent, glabrescent. *Twig* to 1 mm  $\varnothing$  apically, slender, becoming smooth, glabrous. *Bud* to 2 by 1 mm, ovoid, acute. *Stipule* to 2 mm long, narrowly oblong, acute. *Leaves* 9–18 by 4–7 cm, thinly coriaceous, narrowly ovate to lanceolate; base broadly cuneate; acumen to 1.4 cm long, narrow; nervation scalariform, nerves



13–15 pairs, dense, slender, prominent beneath, slightly curved, at 40°–60°, with or without short slender secondaries; tertiary nerves dense, slender, scalariform, slightly sinuate, diagonal to nerves; midrib slender, prominent beneath, slightly depressed above; *petiole* 1–1.2 cm long. *Panicle* to 9 cm long, terminal or axillary, to 2-axillary, terete; singly branched, branchlets to 1.5 cm long, bearing to 5 flowers; *bracteoles* small, ovate, acute, puberulent outside, glabrous within. *Flower bud* to 3 mm long, subglobose. *Petals* narrowly oblong, densely tomentose on parts exposed in bud, purple with pale tips. *Stamens* 15; filaments of inner 2 rows broad at base, abruptly tapering, 5 outer filaments slender; anthers subglobose; appendage to connective slender, c. 2 times length of anther. *Ovary* and *stylopodium* broadly cylindrical, truncate, glabrous; style short. *Fruit* subsessile. *Calyx* glabrous, impressed at base; 2 longer lobes to 12 by 1.8 cm, thinly coriaceous, spatulate, narrowly obtuse, to 2.5 mm broad above the to 13 by 8 mm broadly ovate saccate thickened base; 3 shorter lobes to 1.5 cm long, acute, similar at base, closely adpressed to nut. *Nut* to 1 cm long and  $\varnothing$ , ovoid, style remnant short.

Distr. *Malesia*: Malaya, Borneo (Sarawak to Sabah, S. E. Borneo to Balikpapan).

Ecol. Low lying flat land and hill slopes below 400 m on clay rich fertile soils; locally frequent.

Vern. *Mérawan jangkang*, *m. pēnak*, *chéngal rawan*, *c. pasir* (Mal.), *sēlangan puteh*, *s. bērtunjang*, *damar jangkar* (S.E. Borneo).

**30. *Hopea sublanceolata*** SYM. Gard. Bull. S. S. 10 (1939) 341, pl. 13; Mal. For. Rec. 10 (1943) 144, f. 69. — *H. nervosa* (non KING) FOXW. Mal. For. Rec. 10 (1932) 129, p.p.

Medium-sized, sometimes large, tree with reddish flaky bark. Young twigs and petioles fugaceous puberulent, calyx outside caducously so, panicles sparsely persistently so; petals densely cream pubescent outside. *Twig* c. 2 mm  $\varnothing$ , dark brown, with a short rib following the leaf trace otherwise smooth, terete; internodes 1–2 cm long; stipule scars obscure. *Leaf bud* minute, ovoid; *stipule* fugaceous. *Leaves* 6.5–15 by 3.5–6.5 cm, elliptic-lanceolate, subcoriaceous; base cuneate, typically shortly decurrent; acumen to 1.5 cm long; nerves 13–18 pairs, arched, slender but prominent beneath, depressed above as also the midrib; occasionally with a few short secondary nerves; tertiary nerves densely scalariform, evident beneath, obscure above; *petiole* 7–20 mm long. *Panicle* to 5 cm long, terminal or axillary, ramiflorous, relatively short, singly branched; branchlets to 2.5 cm long, bearing to 8 flowers. *Flower buds* to 3 by 2 mm, ovoid. 2 outer *sepals* ovate, deltoid, acute; 3 inner broadly ovate, subacuminate. *Corolla* dark red. *Stamens* 15. *Ovary* and *stylopodium* cylindrical, truncate, with slight median constriction, the *stylopodium* the shorter and narrower; style short, stout. *Fruit pedicel* c. 1 mm long, short, stout, base of fruit shallowly depressed. 2 longer fruit *calyx lobes* to 11.5

by 2 cm, spatulate, obtuse, c. 4 mm broad above the to 8 by 8 mm ovate saccate thickened base; 3 shorter lobes to 17 by 12 mm, ovate-acuminate, appressed to nut and enclosing it except at apex. *Nut* to 2 by 1.3 cm, shortly apiculate.

Distr. *Malesia*: Malaya (S. Kedah, N. Perak, Kelantan, Pahang).

Ecol. Locally common on undulating land and low spurs.

Vern. *Mérawan jēruai*, *chéngal karang*, *mata puteh*, *panah*, *pau yang*, *pahi yang*.

**31. *Hopea nigra*** BURCK, Ann. Jard. Bot. Btzig 6 (1887) 238; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64; MERR. En. Born. (1921) 403.

Small tree. Twigs, leaf buds, stipules and parts of petals exposed in bud densely persistently tawny pubescent; panicles sparsely  $\pm$  caducously so. *Twigs* c. 2 mm  $\varnothing$  apically, rather straight, hardly branched, becoming smooth, terete. *Buds* minute, subglobose; *stipules* c. 2.5 mm long, linear, not at first caducous. *Leaves* 3–10 by 1–4 cm, broadly lanceolate, subcoriaceous; base obtuse; acumen to 1.5 cm long, slender; nerves 8–10 pairs, very slender,  $\pm$  elevated or obscure beneath, applanate or narrowly depressed above, arched, sometimes with small pubescent domatia; secondary nerves  $\infty$ , short, obscure; tertiary nerves subscalariform, obscure; midrib sharply prominent beneath,  $\pm$  obscure and depressed above; *petiole* 3–6 mm long, short, slender. *Panicle* to 3 cm long, short, slender, axillary, usually solitary; singly branched, branchlets to 1 cm long, bearing c. 4 second flowers; *bracts* and *bracteoles* to 2 mm long, linear, subsistent. *Flower bud* to 2 by 1 mm, small, ovoid. 2 outer *sepals* narrowly ovate-acuminate, 3 inner suborbicular, mucronate, sparsely fimbriate; *stamens* 15, in 3 subequal verticils, exceeding style; filaments broadly compressed at base, tapering and filiform below the small subglobose anthers; appendages 2–3 times length of anthers, very slender. *Ovary* and *stylopodium* cylindrical, truncate, punctate distally; style c.  $\frac{1}{2}$  length of ovary and *stylopodium*, filiform. *Fruit pedicel* short. 2 longer calyx lobes to 5.5 by 1 cm, spatulate,  $\pm$  subacute, tapering to 2 mm broad above the to 6 by 4 mm ovate saccate somewhat thickened base; 3 shorter lobes to 4 by 5 mm, suborbicular, obtuse or mucronate. *Nut* to 8 by 6 mm, ovoid, retaining the prominently truncate *stylopodium*.

Distr. *Malesia*: E. Sumatra, Banka, Billiton.

Ecol. Lowland forests.

Vern. *Mēdēmut*, *sasak lingga* (Banka), *mang* (Billiton).

**32. *Hopea sphaerocarpa*** (HEIM) ASHTON, Gard. Bull. Sing. 20 (1963) 258; Man. Dipt. Brun. Suppl. (1968) 56, f. 8. — *Balanocarpus sphaerocarpus* HEIM, Rech. Dipt. (1892) 77; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 113; MERR. En. Born. (1921) 407.

Small tree. Twigs, petioles, buds and midrib on both surfaces  $\pm$  densely persistently evenly tawny pubescent, leaf nervation sometimes sparsely so. *Twig*



Fig. 71. Stilt-rooted *Hopea nervosa* KING. Sabah (Photogr. G.H.S. WOOD).

*c.* 1 mm  $\varnothing$  apically, terete, straight, lax, smooth. *Bud* *c.* 1 by 1 mm, small. *Stipule* *c.* 4 by 2 mm, oblong, obtuse, caducous. *Leaves* 3.5–10 by 1.4–4.5 cm, ovate to broadly lanceolate, chartaceous, undulate; base obtuse to subcordate; acumen to 1 cm long; nervation subdryobalanoid, main nerves 9–11 pairs, slender, elevated beneath, with obscure short secondaries; tertiary nerves densely scalariform, slender; midrib slender, elevated beneath, applanate above; *petiole* 3–6 mm long, short. *Panicle* to 10 cm long, axillary, sometimes terminal, lax, slender, glabrous; singly branched, branchlets zig-zag, bearing to  $6 \pm$  distichous flowers; *bracteoles* *c.* 2 mm long, linear, glabrous, subsistent. *Flower bud* to 2 by 2 mm, subglobose. *Sepals* broadly ovate, subacute, sub-

equal, densely shortly pubescent on parts exposed in bud. *Petals* elliptic-oblong, subacute, puberulent on parts exposed in bud, dark crimson. *Stamens* 15, in 3 unequal rows; filaments broad and compressed at base, tapering abruptly and filiform beneath the subglobose anthers; appendage to connective 3–5 times as long as anther, slender. *Ovary* and *stylopodium* cylindrical, truncate, somewhat constricted medially, glabrous; style short, conical. *Fruit* glabrous. *Pedice*l to 4 mm long, very long. *Calyx lobes* to 8 by 7 mm, subequal, ovate, acute, saccate, thickened. *Nut* to 10 by 8 mm, ovoid; stylopodium to 2 mm tall, prominent, truncate.

*Distr. Malesia:* Borneo (W. and N. E. Sarawak; N.W. Kalimantan).



Ecol. Local; Mixed Dipterocarp forest on leached clay-rich soils on low hills.

**33. *Hopea mesuoides*** ASHTON, Gard. Bull. Sing. 22 (1967) 279, pl. 25; Man. Dipt. Brun. Suppl. (1968) 54. — *H. subalata* (non SYM.) ASHTON, Man. Dipt. Brun. (1964) 110, f. 12, pl. 27 (stem-base).

Medium-sized tree. Leaf bud and stipule shortly persistently pale yellow-brown pubescent, other parts glabrous. *Twig* to 1.5 mm  $\varnothing$  apically, slender, smooth, terete. *Bud* to 1 mm long, subglobose. *Stipule* to 2.5 by 1 mm, hastate, acute, fugaceous. *Leaves* 8–14 by 2.5–5 cm, thinly coriaceous, ovate; base obtuse; acumen 5–15 mm long, caudate; margin subrevolute; nerves *c.* 11 pairs, subdryobalanoid, distinct, slightly raised beneath, with shorter secondaries, at 55°–75°, strongly curved; tertiary nerves reticulate; midrib prominently raised beneath, narrow, depressed above, *petiole* 7–10 mm long, slender. *Panicle* to 4 cm long, axillary, short, terete, glabrous, singly branched; *bracteoles* to 1 mm long, deltoid, glabrous, subpersistent. *Flower bud* small, ovoid to subglobose. *Calyx* sparsely pubescent outside, glabrous within; 2 outer lobes suborbicular, subacute or obtuse; 3 inner lobes suborbicular,  $\pm$  shortly mucronate. *Petals* oblong, obtuse, pubescent on parts exposed in bud. *Stamens* 15; filaments broad at base, tapering; anthers subglobose; appendage to connective 2–3 times length of anther, very slender. *Ovary* and *stylopodium* glabrous but for the puberulent apex, cylindrical, truncate, ovary slightly the broader; style short, glabrous. *Fruit pedicel* *c.* 1 mm long, short, impressed in the base of the calyx. *Calyx lobes* to 14 by 12 mm, subequal, ovate, chartaceous,  $\pm$  erose at the subacute apex, broadly imbricate, saccate, completely enclosing the nut and closely adpressed to it. *Nut* to 14 by 14 mm, subglobose, crowned by the persistent truncate stylopodium.

Distr. *Malesia*: Borneo (Sarawak N. E. of Baligian, Brunei).

Ecol. Mixed Dipterocarp and Heath forests, deep leached soil, lowlands.

**34. *Hopea subalata*** SYM. Gard. Bull. S. S. 10 (1939) 339, pl. 12; Mal. For. Rec. 16 (1943) 143, f. 68A, 69, 78. — *Balanocarpus ovalifolius* (non RIDL.) FOXW. Mal. For. Rec. 10 (1932) 143, p.p.

Small tree. Twigs and petioles sparsely fugaceous puberulent, petals outside cream pubescent, parts otherwise glabrous. *Twig* *c.* 1 mm  $\varnothing$  apically, slender, dark brown, at first ribbed along the leaf traces; internodes 1.5–2.5 cm long; stipule scars obscure. Leaf bud minute, ovoid; *stipule* to 5 mm long, linear, caducous. *Leaves* 4.5–10 by 2.3–5 cm, ovate-lanceolate, thinly coriaceous; base broadly cuneate; acumen to 1.5 cm long, subcuspidate; nervation subdryobalanoid; main nerves *c.* 12 pairs, arched, frequently with small pubescent axillary domatia, slender but distinctly elevated beneath, obscurely depressed above as also the many shorter secondaries; tertiary nerve subscalariform, obscure; midrib sharply promi-

nent beneath, narrowly depressed above; *petiole* 5–7 mm long, short. *Panicle* to 5 cm long, axillary at terminal, slender, lax, with to 2.5 cm long branchlets bearing to 5 flowers; *bracteoles* to 1 mm long, deltoid, apiculate, subpersistent. *Flower buds* to 3 by 2 mm, ovoid; sepals suborbicular, obtuse or subacute, subequal; *petals* purple; *stamens* 15, filaments short, compressed, tapering immediately beneath the subglobose anthers; appendages very slender, 2–4 times length of anthers; *ovary* and *stylopodium* cylindrical, equal, subtruncate, punctate distally, with short stout tapering style. *Fruit pedicel* to 2 mm long and  $\varnothing$ . *Fruit calyx lobes* to 10 by 8 mm, ovate, subequal, saccate, thickened, enclosing the nut (the apex excepted), 1(–2) lobes generally with a to 10 by 3 mm aliform apical extension. *Nut* to 10 by 8 mm, ovoid, crowned by a truncate conical stylopodium with central terminal apiculus.

Distr. *Malesia*: Malaya (Selangor).

Ecol. Locally common in one locality, on low hills.

Vern. *Mérawan kanching*, *m. jangkang*.

**35. *Hopea auriculata*** FOXW. Mal. For. Rec. 10 (1932) 125, pl. 9; BURK. Dict. (1935) 1189; SYM. Mal. For. Rec. 16 (1943) 121, f. 69.

Small tree. Young twigs and petioles caducous pale grey-tawny puberulent. *Twig* *c.* 2 mm  $\varnothing$  apically, slender, horizontal; stipule scars minute. *Leaf bud* minute; stipule acicular, fugaceous. *Leaf* 5–10 by 2–5 cm, ovate-lanceolate, thinly coriaceous; base cuneate; acumen to 1.5 cm long, caudate; nervation subdryobalanoid; nerves *c.* 9 pairs, arched, slender but distinctly elevated beneath, obscure above, with  $\pm$  prominently buff pubescent axillary domatia and short slender secondary nerves; tertiary nerves densely subscalariform,  $\pm$  obscure; midrib slender but prominent beneath, obscurely depressed above; *petiole* 5–11 mm long, slender. *Panicle* to 4 cm long, slender, hardly branched; *flowers* unknown. *Fruit pedicel* to 2 mm long; 2 longer *calyx lobes* to 7 by 1.5 cm, spatulate, obtuse, to 5 mm broad above the to 15 by 10 mm auriculate saccate thickened base; 3 shorter lobes to 2 cm long, ovate-auriculate, similarly thickened centrally; *nut* to 10 by 7 mm, ovoid, apiculate, completely enclosed in calyx.

Distr. *Malesia*: Malaya (N. E. Johore, E. Pahang).

Ecol. Rare, between 250–700 m on ridges.

**36. *Hopea montana*** SYM. J. Mal. Br. R. As. Soc. 19, 2 (1941) 141, pl. 1A; Mal. For. Rec. 16 (1943) 133, f. 69; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 214.

Medium-sized tree. All known parts of mature tree glabrous. *Twig* *c.* 1 mm  $\varnothing$  apically, very slender, straight, blackish; stipule scars obscure. *Leaf bud* minute; *stipules* fugaceous. *Leaves* 6.5–9 by 2.2–4 cm, ovate-lanceolate, thinly coriaceous; base abruptly cuneate; acumen to 1 cm long, cuspidate; nervation subdryobalanoid; main nerves *c.* 14 pairs, arched, ascending, with many  $\pm$  shorter secondaries, elevated beneath, obscurely depressed above as also the midrib; tertiary nerves obscure; *petiole* 9–11 mm long, slender. *Flowers* unknown. *Panicle* to 2 cm long,

slender, hardly branched or unbranched. *Fruit pedicel* to 2 mm long, broadening into receptacle. 2 longer *calyx lobes* to 5 by 1.2 cm, spatulate, subacute, tapering to c. 2 mm broad above the to 5 by 3 mm elliptic saccate thickened base; 3 shorter lobes to 10 by 3 mm, ovate, frequently shortly winged apically. *Nut* to 7 by 5 mm, ovoid, the exposed apex surmounted by a truncate stylopodium and central apiculus.

Distr. *Malesia*: Malaya (Perak, Kelantan); Borneo (G. Kinabalu).

Ecol. Rare, hill slopes in upper dipterocarp forest, to 1200 m.

**37. *Hopea vacciniifolia* RIDL.** *ex* [BROWNE, For. Trees Sarawak & Brunei (1955) 122, *nomen*] ASHTON, Gard. Bull. Sing. 19 (1962) 258, pl. 3; Man. Dipt. Brun. (1964) 112, f. 12; *ibid.* Suppl. (1968) 57. — **Fig. 70 C-C4.**

Small tree. Young twig, leaf bud, stipule and petiole densely shortly pale grey-brown pubescent. *Twig* to 0.5 mm  $\varnothing$  apically, slender, much branched, horizontally, becoming smooth, glabrous. *Bud* minute. *Stipule* to 1.2 mm long, narrowly hastate, acute, fugaceous. *Leaves* 1–2.5 by 0.4–1.2 cm, chartaceous, elliptic to broadly ovate; base cuneate; apex obtuse or with to 1.5 mm long obtuse acumen in mature tree; nervation subdribalanoid; main nerves c. 6 pairs, very indistinct with slender secondaries; tertiary nerves reticulate; midrib slender, applanate or slightly raised beneath, narrow and depressed above; *petiole* to 2 mm long, slender. *Panicle* to 1.3 cm long, to 2-axillary, short, terete, glabrous; irregularly singly branched, branchlets short, bearing to 3 flowers; *bracteoles* minute, deltoid, subpersistent, glabrous. *Flower bud* small, ovoid, subsessile. *Calyx* glabrous but for a fimbriate distal margin; 2 outer lobes ovate, acute; 2 inner lobes broadly suborbicular, obtuse, thinner. *Petals* oblong, obtuse, glabrous, strongly contorted, imbricate and forming a tube at base on opening, the distal half becoming abruptly rotate or recurved, dark wine-red. *Stamens* 10, subequal; filaments broad at base, abruptly narrowing and filiform distally; anthers subglobose, the interior cells somewhat the longer; appendage to connective slender, c. 2 times length of anther, reaching apex of stylopodium. *Ovary* and *stylopodium* cylindrical, truncate, glabrous but for the puberulent apical platform; style short, abrupt, glabrous. *Fruit calyx* glabrous; lobes subequal, to 4 by 3.5 mm, ovate, acute or obtuse, thickened, shallowly saccate. *Nut* to 8 by 6 mm, ovoid, glabrous; apex minutely truncate.

Distr. *Malesia*: Borneo (Brunei, N. E. Sarawak at Marudi).

Ecol. Locally abundant; Heath forest on giant podsol on raised beaches, and on sandstone cuestas.

Vern. *Mĕrawan ribu*.

**38. *Hopea bracteata* BURCK.** Ann. Jard. Bot. Btzg 6 (1887) 239; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 111; SYM. Gard. Bull. S. S. 10 (1939) 337; SLOOT. Reinwardtia 3 (1956) 317; ASHTON, Man. Dipt. Brun.

(1964) 97, f. 12; *ibid.* Suppl. (1968) 48; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 229; ASHTON, Gard. Bull. Sing. 31 (1978) 31. — *Balanocarpus curtisii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 131; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 158, t. 191; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 111; BURK. J. Str. Br. R. As. Soc. 81 (1920) 59, fig.; RIDL. Fl. Mal. Pen. 1 (1922) 246; SYM. Gard. Bull. S. S. 8 (1934) 27. — *Balanocarpus bracteatus* MERR. En. Born. (1921) 407; Foxw. Mal. For. Rec. 10 (1932) 142; BURK. Dict. (1935) 284. — *H. minima* SYM. Gard. Bull. S. S. 10 (1939) 337, pl. 11, incl. *var. penangiana* SYM. *et var. perakensis* SYM. l.c. 338; Mal. For. Rec. 16 (1943) 133, f. 69. — **Fig. 70 A-A4.**

Small, occasionally medium sized, tree. Twig, leaf bud, stipule and petiole shortly persistently grey-brown puberulent. *Twig* to 0.7 mm  $\varnothing$  apically, slender, terete, much branched, becoming smooth, glabrous. *Bud* to 2.5 mm long, lanceolate. *Stipule* to 3 mm long, linear, fugaceous. *Leaves* 2.5–6 by 0.7–2 cm, thin, narrowly ovate, base cuneate; acumen to 1.5 cm long; nerves c. 11 pairs, slender, hardly more distinct than secondaries, at 55°–65°, strongly curved; tertiary nerves slender, reticulate; midrib slender but raised beneath, narrow, depressed above; *petiole* 2–4 mm long, slender. *Panicle* to 9 cm long, terminal or axillary, very slender, lax, terete, glabrous; remotely irregularly singly or doubly branched, branchlets to 3 cm long, zigzag, bearing to 5 flowers; *bracteoles* to 1 mm long, deltoid, glabrous. *Bud* to 3 mm long, subglobose, distinctly pedicellate. *Calyx lobes* fimbriate, otherwise glabrous; outer lobes suborbicular, thin; inner lobes suborbicular, mucronate, thin. *Petals* oblong, acute, densely shortly tomentose on parts exposed in bud, dark red with pale tips. *Stamens* 15; filaments broad at base, tapering; anthers subglobose; appendage to connective c. 2 times length of anther, slender, joining abruptly with the distinctly broader connective and filament. *Ovary* and *stylopodium* glabrous, cylindrical, truncate, ovary only slightly the broader; style short, abrupt, glabrous. *Fruit* entirely glabrous. *Calyx lobes* to 5 by 5 mm, subequal, broadly ovate, obtuse, incassate at base but for a chartaceous margin. *Nut* to 9 by 6 mm, ovoid; apex minutely truncate.

Distr. *Malesia*: Malaya (Penang, Perak), Borneo (Sarawak, Brunei, Sandakan, S.E. Borneo to Puruktjau).

Ecol. Locally abundant on spurs and ridges below 650 m.

Vern. *Mĕrawan ungu*, *damar mata kucing* (Mal.), *m. padi* (Brun.), *bangkirai* (S.E. Borneo).

Note. The rare *H. brachyptera* (FOXW.) SLOOT. of Zamboanga (Mindanao, Philippines) closely resembles *H. bracteata* though the leaf is somewhat larger. According to FOXWORTHY (Philip. J. Sc. 13, 1918, Bot. 195; *ibid.* 67, 1938, 285) the ovary differs in being densely pubescent. I have seen neither flowers nor fruit, which may all have been lost in the destruction of the Manila Herbarium in 1945.

**39. *Hopea brachyptera* (FOXW.) SLOOT.** Reinwardtia 3



(1956) 317. — *Balanocarpus brachypterus* FOXW. Philip. J. Sc. 13 (1918) Bot. 195; *ibid.* 67 (1938) 285; MERR. En. Philip. 3 (1923) 101; SYM. Gard. Bull. S.S. 8 (1934) 27, 28.

Medium-sized tree. Leaf buds, twigs and petiole, midrib above and outside of calyx sparsely  $\pm$  caducous puberulent; petals outside, ovary and domatia densely persistently pubescent. *Twigs* c. 1 mm  $\varnothing$  apically, terete, dark brown,  $\pm$  rugose. *Leaves* 3.5–7 by 2.3–3.5 cm, ovate-lanceolate, chartaceous; base unequal, cuneate; acumen to 12 mm long, slender, subcaudate; nerves 9–11 pairs, slender but prominent beneath, obscure and adpressed above, arched; secondary nerves many but very short; both  $\pm$  continuously furnished with pubescent domatia; tertiary nerves subscalariform, distinct but hardly elevated; *petioles* 3–5 mm long, very slender. *Flowers* to 3

mm long, dull, violet. *Sepals* ovate, acute. *Stamens* 15; filaments filiform, slightly expanded at base; appendages aristate, considerably longer than oblong anthers. *Ovary* and *stylopodium* cylindrical, truncate, with short style. *Fruit* calyx lobes short, subequal, ovate, adpressed to and hiding the 10 by 9 mm nut except at apex.

Distr. *Malesia*: Philippines (Zamboanga, Mindanao).

Ecol. Rare, lowland forests.

Vern. *Babase* (Sub.).

Note. The flower and fruit description are taken from FOXWORTHY; both material seems to have been completely destroyed during the burning of the Philippine herbarium. See the note under the preceding species *H. bracteata*.

## 2. Section Hopea

ASHTON, Gard. Bull. Sing. 20 (1963) 258; Man. Dipt. Brun. (1964) 91; GUTIERREZ, Act. Manil. 4, A, 2 (1968) 25, 26. — *Hopea* sect. *Euhopea* MIQ. Sum. (1862) 192, as subgenus, 489, as section; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 237, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 3 (1895) 57; FOXW. Philip. J. Sc. 6 (1911) Bot. 260; Mal. For. Rec. 10 (1932) 118. — *Hopea*, *Euhopea* group SYM. Gard. Bull. S. S. 8 (1934) 72; Mal. For. Rec. 16 (1943) 108. — **Fig. 72, 74.**

Nervation scalariform; panicles irregularly branched, many flowered, flowers pale; bark surface smooth or evenly flaky. Wood with markedly heterogeneous rays; without chambered parenchyma strands (excepting *H. pachycarpa*).

### 2a. Subsection Hopea

*Neisandra* RAFIN. — *Petalandra* HASSK. — *Balanocarpus* BEDD. — *Dioticarpus* DUNN. — *Hopea* sect. *Petalandra* HEIM, Rech. Dipt. (1892) 63; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 65; FOXW. Philip. J. Sc. 6 (1911) Bot. 264; Mal. For. Rec. 10 (1932) 130. — *Balanocarpus* sect. *Pachynocarpoides* HEIM, Rech. Dipt. (1892) 75 *et* sect. *Microcarpae* HEIM, *l.c.* 76. — **Fig. 72.**

Panicles generally tomentose, rarely fascicled; ovary and stylopodium  $\pm$  ovoid, or, if elongate, without median constriction; style evident. Large, less often small, trees, usually with flaky bark and buttresses, but rarely stilt-rooted.

Distr. Throughout the range of the genus.

**40. *Hopea celtidifolia*** KOSTERM. Gard. Bull. Sing. 22 (1968) 443; ASHTON, Gard. Bull. Sing. 31 (1978) 32.

Medium-sized scaly barked buttressed tree. Young twigs, leaf buds and stipules densely  $\pm$  persistently tawny puberulent, petioles caducously so. *Twig* c. 1 mm  $\varnothing$  apically, much branched; internodes short. *Buds* small, ovoid, subacute; *stipules* small, fugaceous. *Leaves* 5–10 by 3–4.5 cm, elliptic to lanceolate, coriaceous, margin subrevolute; base obtuse to

broadly cuneate; acumen to 8 mm long, slender; nerves 4–5 pairs, frequently all arising from the proximal  $\frac{1}{2}$  of the leaf, arched and coalescing midway to the margin forming an almost unlooped continuous prominent intramarginal nerve continuing to the acumen, the whole slender but prominent beneath, distinctly elevated above; intramarginal nerve with indistinct lateral branches to the margin; tertiary nerves scalariform, evident beneath; midrib stout,

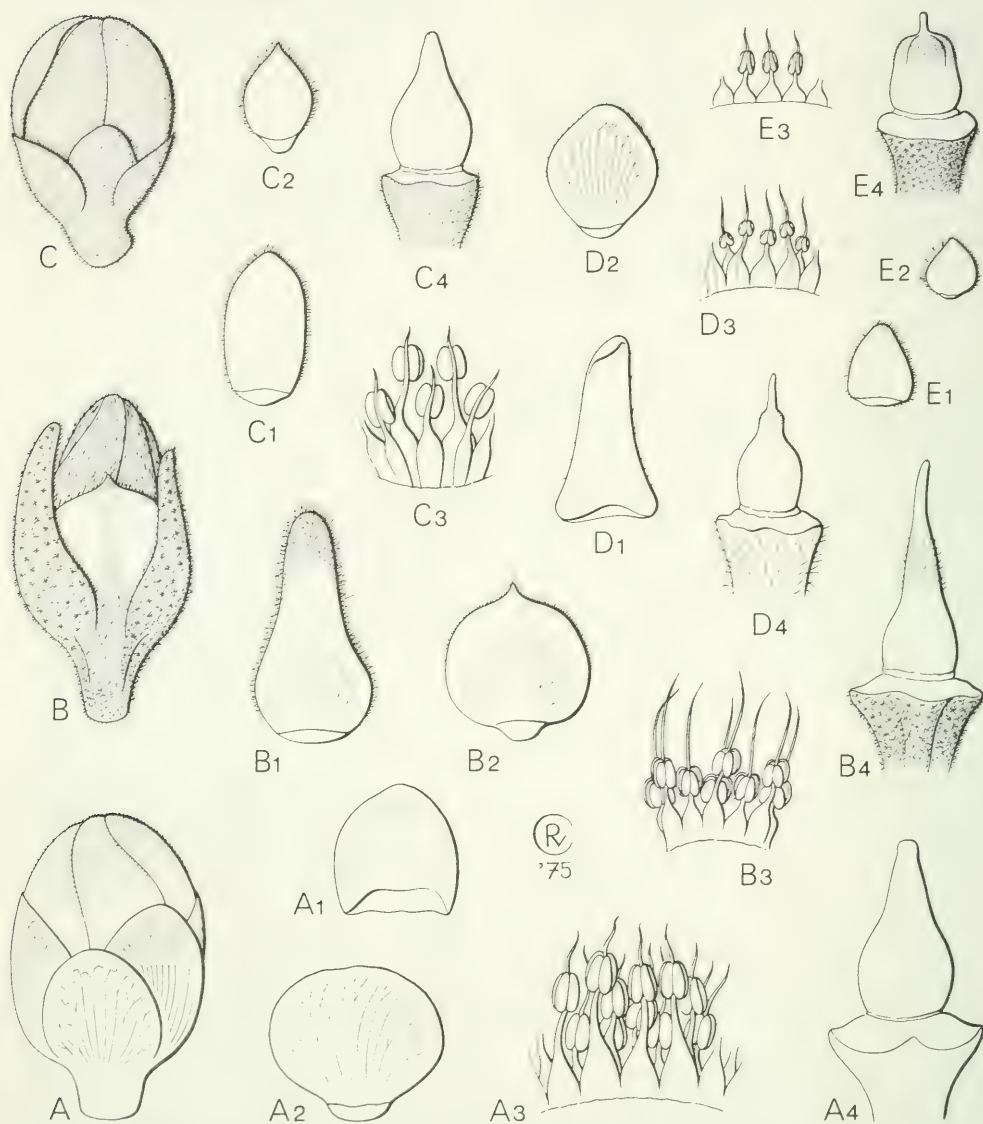


Fig. 72. Flower details in *Hopea* sect. *Hopea* subsect. *Hopea*. All  $\times 10$ . Sepals drawn from inside. — *H. plagata* (BLCO) VIDAL. A. Bud, A1. outer sepal, A2. inner sepal, A3. stamens from inside, A4. pistil. — *H. forbesii* (BRANDIS) SLOOT. B. Bud, B1. outer sepal, B2. inner sepal, B3. stamens from inside, B4. pistil. — *H. ferrea* LANESS. C. bud, C1. outer sepal, C2. inner sepal, C3. stamens from outside, C4. pistil. — *H. centipeda* ASHTON. D1. Outer sepal, D2. inner sepal, D3. stamens from inside, D4. pistil. — *H. sangal* KORTH. E1. Outer sepal, E2. inner sepal, E3. stamens from inside, E4. pistil (A PNH 78168, B CARR 12072, C1–C2 PHENG-NAREN, C, C3–C4 PUT 4307, D S 23342, E KEP 76619).



prominent beneath, elevated above; *petiole* 8–10 mm long, slender. *Panicle* unknown; *flowers* unknown. *Fruit pedicel* c. 2 mm long, stout; 2 longer *calyx lobes* to 5 by 1 cm, spatulate, obtuse, c. 2 mm broad above the to 6 by 3 mm narrowly ovate saccate thickened base; 3 shorter lobes to 5 by 4 mm, ovate, obtuse to acute, similarly saccate. *Nut* to 15 by 6 cm, narrowly ovoid, the stylopodium showing as a prominent medially thickened apiculus.

Distr. *Malesia*: W. New Guinea (R. Digoel, Muku Subdistr.); S. New Guinea; Strickland R., E. New Guinea.

Ecol. Local in lowland forest.

Vern. *Et, teh, keilmoen, katiau, jeruieh.*

**41. *Hopea dasyrrhachis*** SLOOT. Bull. Bot. Gard. Btzg III, 17 (1941) 130, f. 18; ASHTON, Gard. Bull. Sing. 31 (1978) 32. — *Isoptera dasyrrhachis* SLOOT. ex DEN BERGER & ENDERT, Med. Proefst. Boschw. 9 (1925) 117, *nomen*. — *Shorea dasyrrhachis* SLOOT. ex ENDERT, Tectona 28 (1935) 282, 295, *nomen*.

Large, dark flaky-barked tree. Twig apices, ovary apex and calyx caducous buff puberulent, panicles and parts of corolla exposed in bud persistently densely so. *Twig* c. 2 mm  $\varnothing$ , terete; stipule scars short, obscure. *Bud* 1 by 1 mm, minute. *Stipule* fugaceous. *Leaves* 7–15 by 2.5–8 cm, ovate-falcate, somewhat coriaceous, base cuneate; acumen to 1.5 cm long; nerves 12–14 pairs, slender, arched, at 50°–60°; typically with prominent glabrous pore-like axillary domatia; tertiary nerves slender, scalariform; midrib raised on both surfaces; *petiole* 5–15 mm long. *Panicle* to 8.5 cm long, terete, singly branched, branchlets bearing to 10 second flowers. *Flower bud* to 2 mm long, ovoid, 3 outer *calyx lobes* ovate, subacute, 2 inner suborbicular, villous on parts exposed in bud. *Petals* pubescent on parts exposed in bud, cream. *Stamens* 10, in a single verticil; filaments compressed at base, tapering abruptly medially, filiform at the base of the oblong anthers; appendage to connective filiform, as long as anther. *Ovary* and *stylopodium* subcylindrical, sericeous in the distal half, terminating in a short truncate style. *Fruit pedicel* to 3 mm long, slender, 2 longer *calyx lobes* to 4 by 3.5 cm, suborbicular, chartaceous, frequently subauriculate with to 4 by 3 mm small thickened area at base; 3 shorter lobes to 6 by 7 mm, suborbicular, saccate. *Nut* to 15 by 15 mm, ovoid, shortly apiculate.

Distr. *Malesia*: Borneo (Kapuas valley, Lower Dyak, C. Dusun, Marabahan).

Ecol. On river banks in W. and S. Borneo.

Vern. *Damar puteh* (S. Borneo), *tēkam, t. lampung, t. rayap, t. ayēr* (W. Borneo).

**42. *Hopea similis*** SLOOT. Reinwardtia 2 (1952) 30; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 41.

Medium-sized, buttressed tree with flaky bark. Leaf buds, twigs, petioles and panicles  $\pm$  persistently somewhat scabrid buff pubescent, parts of petals exposed in bud evenly so; calyx and leaf nervation

below caducously so, glabrescent. *Twig* c. 2 mm  $\varnothing$  apically, stout, rugose, becoming ribbed; stipule scars distinct, short,  $\pm$  horizontal. *Bud* small, ovoid; *stipules* unknown, caducous. *Leaves* 10–22 by 3.5–8 cm, elliptic-oblong to lanceolate, coriaceous; margin revolute (less so in young trees); base obtuse to subcordate; acumen to 8 mm long, short, broad; nerves 12–16 pairs, prominent beneath, evident and elevated above; *petiole* 11–14 mm long, c. 2 mm  $\varnothing$ , rather stout. *Panicle* to 6 cm long, axillary to ramiflorous, slender, to 2-axillary; singly branched, branchlets to 1.5 cm long, bearing up to 6 flowers. *Flower buds* to 4 by 2 mm, lanceolate; 2 outer *sepals* broadly lanceolate-acuminate, 3 inner suborbicular, obtuse, fimbriate. *Stamens* 15, in 3 subequal verticils; filaments broad and compressed at base, tapering and filiform beneath the subglobose anthers; appendages  $2\frac{1}{2}$ –3 times length of anther, slender. *Ovary* and *stylopodium* narrowly pyriform, slightly constricted medially; stylopodium punctate distally, surmounted by a short columnar style. *Fruit pedicel* to 3 mm long, stout, 2 longer *calyx lobes* to 7.5 by 1.5 cm, obtuse, c. 2 mm wide above the to 8 by 4 mm narrowly ovate prominently saccate thickened base; 3 shorter lobes to 8 by 6 mm, ovate, mucronate or obtuse, similarly saccate; *nut* to 15 by 7 mm, narrowly ovoid, tapering, prominently slender-apiculate.

Distr. *Malesia*: *New Guinea* (Rouffaer river, W. Irian; Milne Bay Distr., Woitaki, Paiawa, and Northern Distr. Papua).

Ecol. Local, especially on ridges, in lowland (including *Anisoptera* and oak *Castanopsis*) forests; also recorded from freshwater swamp.

Vern. *Lomas* (Waigani), *koperitoma* (Upper Waria).

**43. *Hopea forbesii*** (BRANDIS) SLOOT. Reinwardtia 5 (1961) 477; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 34. — *Shorea forbesii* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 92; BAKER f. J. Bot. 61, Suppl. (1923) 5; SLOOT. Reinwardtia (1952) 61, f. 20. — **Fig. 72 B-B4.**

Tall, flaky-barked, hard-wooded tree. Young parts densely buff pubescent, leaf buds, stipules, twig apices, petioles, and parts of corolla expanded in bud persistently so, becoming sparse on leaf undersurface and calyx, caducous elsewhere. *Twig* c. 1 mm  $\varnothing$  apically, becoming smooth, terete; internodes short, branchlets hence densely leaved. *Buds* minute, ovoid; *stipules* to 4 by 1 mm, linear-lanceolate, caducous. *Leaves* 5.5–11 (to 13 in young trees) by 1.8–4 cm, lanceolate, thinly coriaceous; margin subrevolute; base obtuse,  $\pm$  equal; acumen to 13 mm, slender; nerves (11–)13 to 15 pairs, dense, slender but prominent beneath,  $\pm$  obscure and depressed above as also the midrib, without domatia; tertiary nerves scalariform,  $\pm$  evident but unraised beneath; *petiole* 5–8 mm long. *Panicle* to 3.5 cm long, slender, to 2-axillary, singly branched; branchlets to 12 mm long, bearing to 5 second flowers; *bracteoles* to 2 mm long, deltoid, not at first caducous. *Flower bud* to 3 by 2 mm, lanceolate.





Medium-sized, unbuttressed tree with flaky bark. Twigs, petioles, panicles and calyx densely pale tawny puberulent, midrib beneath sparsely so; parts of petals exposed in bud densely pubescent. *Twigs* c. 2 mm  $\varnothing$  apically, terete,  $\pm$  rugose, pale brown, becoming smooth. *Leaves* 6–17 by 3–6 cm, oblong, subsericeous; base subcordate,  $\pm$  equal, margin narrowly revolute; acumens to 5 mm long, stout; nerves 16–18 pairs, slender but prominent beneath, at 50°–65°; tertiary nerves slender, barely elevated, scalariform; midrib slender but prominent beneath, elevated above; *petiole* 9–14 mm long. *Panicles* to 5(–8) cm long, 3-axillary to ramiflorous or sometimes terminal, short, slender; 1–2 branched, the branchlets bearing to 6 secund flowers. *Flower buds* to 5 by 2 mm, ellipsoid. *Sepals* unequal, the outer 2 lanceolate, inner 3 ovate, erose. *Stamens* 15; filaments dilated at base, tapering medially; anthers subglobose; appendage  $2\frac{1}{2}$ –3 times length of anthers, aristate. *Ovary* and *stylopodium* narrowly fusiform, tapering into a shorter style. *Fruit* unknown.

Distr. *Malesia*: E. New Guinea (Milne Bay area, Normanby I.).

**47. *Hopea novoguineensis*** SLOOT. Nova Guinea 14 (1924) 224, t. 19; Reinwardtia 2 (1952) 31; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 38. — *H. celebica* (non BURCK) DIELS, Bot. Jahrb. 57 (1922) 462.

Medium-sized, flaky-barked tree with tall buttresses. Parts of petals exposed in bud, panicles, bracts and stipules densely persistently buff pubescent; calyx, twigs and petiole caducously so. *Twig* c. 2 mm  $\varnothing$  apically, becoming smooth, terete, blackish. Buds minute, ovoid; stipules to 4 by 2 mm, lanceolate, acute, caducous. *Leaves* 10–28 by 3.5–10 cm, variable in size and shape, chartaceous, undersurface pale and dull, margin  $\pm$  revolute; base  $\pm$  prominently unequal, cuneate abaxially, the adaxial side cuneate to deeply cordate; acumens to 1 cm long, slender; nerves (11–)14–16 pairs, slender but prominent beneath, narrowly elevated above, arched, at 50°–65°, usually with  $\pm$  prominent glabrous porous canaliculate domatia; tertiary nerves densely scalariform, slender, evident beneath; *petiole* 9–15 mm long. *Panicle* to 9 cm long, to 3-axillary or terminal, singly branched; branchlets to 2.5 cm long, bearing to 4 flowers; *bracteoles* to 2 by 2 mm, ovate, acute. *Flower buds* to 3 by 2 mm, ovoid. *Sepals* subequal, broadly ovate, acute. *Stamens* 15, shorter than style, in 3 subequal verticils; filaments compressed and broad at base, tapering to the subglobose anthers; appendages  $\pm$  equal to length of anthers, slender. *Ovary* small, tapering into a distinct equally long subcylindrical stylopodium and short style. *Fruit pedicel* to 3 mm long, stout. 2 longer *calyx lobes* to 8 by 2 cm, spatulate, obtuse, c. 5 mm broad above the to 5 by 4 mm ovate saccate thickened base; 3 shorter lobes to 7 by 4 mm, ovate, acuminate, shorter than nut. *Nut* to 17 by 8 mm, narrowly ovoid, tapering, prominently apiculate.

Distr. *Malesia*: New Guinea (Sorong Distr., and Munju Subdiv., South New Guinea, W. Irian; Western Distr. T.P.N.G.), Moluccas (Halmahera).

Ecol. Common in lowland forest.

Vern. *Puwokigih*, *woigik*, *wokidjih* (Mooi), *arid* (Mandobo), *kielmun* (Muju), *tanjung* (Halmahera).

Note. Very variable, especially in the depth of the cordate leaf base and in the lustrousness of the laminar surface; it is possible that further collections will show there to be more than one species.

**48. *Hopea scabra*** ASHTON, Gard. Bull. Sing. 31 (1978) 33, non BUCH.-HAM. Mem. Wern. Soc. 6 (1832) 300, *nom. inval.*, in *syn.*

Medium-sized buttressed tree. Twigs, petioles, leaf buds and stipules  $\pm$  persistently pale rufous scabrid pubescent, leaf nervation below and midrib above sparsely but distinctly so; calyx outside fugaceous puberulent. *Twigs* c. 2 mm  $\varnothing$  apically, much branched, becoming terete, smooth, pale brown. *Leaf buds* minute, ovoid; stipules to 7 by 3 mm, lanceolate, caducous. *Leaves* 6.5–17 by 2.3–6.5 cm, oblong to lanceolate-falcate, coriaceous; margin subrevolute; base unequal, cordate; acumens to 1.5 cm long,  $\pm$  caudate, slender; nerves 15–24 pairs; slender but prominent beneath, obscurely  $\pm$  shallowly depressed above, arched, at 70°–80°, with many short but distinct secondary nerves; tertiary nerves scalariform, distinctly elevated beneath; midrib slender but prominent beneath, elevated above; *petiole* 4–6 mm long. *Panicle* to 4.5 cm long, short, slender, 1-axillary, singly branched, branchlets to 13 mm long, bearing to 4 flowers; *bracts* to 1 mm long, deltoid, acute. *Flower buds* at anthesis unknown. *Very young fruit* with 2 narrowly deltoid-acuminate outer sepals, 3 suborbicular fimbriate obtuse inner sepals, and ovoid ovary surmounted by a slightly narrower, equally long, prominent stylopodium and short but distinct style. *Fruit pedicel* short. 2 longer *calyx lobes* to 8 by 1.8 cm, spatulate, obtuse, 2 mm wide above the to 5 by 4 mm ovate deeply saccate thickened base; 3 shorter lobes to 8 by 6 mm, ovate, acuminate, similarly saccate. *Nut* to 8 by 6 mm, ovoid; stylopodium prominent, tapering.

Distr. *Malesia*: W. New Guinea (Hollandia Div., Madang).

Ecol. Clay soils on undulating land, locally frequent.

**49. *Hopea papuana*** DIELS, Bot. Jahrb. 57 (1922) 461; SLOOT. Reinwardtia 2 (1952) 33, f. 11; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 40.

Medium-sized tree with dark flaky bark. Twigs, petioles, leaf buds and stipules persistently rufous scabrid tomentose; nerves below and midrib on both surfaces thus at first,  $\pm$  glabrescent. *Twigs* c. 3 mm  $\varnothing$  apically, stout,  $\pm$  persistently ribbed, pale brown; stipule scars prominent, descending. *Buds* to 2 by 2 mm, ellipsoid, obtuse; stipules to 12 by 5 mm, lanceolate, subpersistent. *Leaves* 11–28 by 4.2–10 cm, large, oblong, coriaceous; base  $\pm$  unequal, cordate; acumens to 2.5 cm long, tapering; nerves 16–24 pairs,

arched towards the margin, at 70°–80°, slender but prominent beneath, applanate above, without domatia or secondaries; tertiary nerves scalariform, barely evident beneath; midrib prominent beneath, elevated above; *petiole* 5–7 mm long, stout. *Complete panicle* unknown, short, 1-axillary, glabrous. *Flowers* unknown. *Fruit pedicel* short, stout. 2 longer *calyx lobes* to 5.5 by 1.8 cm, broadly spatulate, obtuse, *c.* 2 mm broad above the to 6 by 5 mm ovate saccate thickened base; 3 shorter lobes to 9 by 6 mm, ovate, subacute, similarly saccate. *Nut* to 16 by 9 mm, narrowly ovoid, tapering to a prominent stout apiculate stylopodium.

Distr. *Malesia*: New Guinea (Hollandia Div.; R. Digul, Muju, in S. New Guinea; Idenburg R.; Papua New Guinea: Central Distr., Amau hinterland, and Western Highlands).

Ecol. Locally abundant; alluvium, low hills, river banks (W. Irian); once on ridges with *Araucaria linkii* in Papua New Guinea.

Vern. *Gointa* (Western Highlands), *riheu* (Nemo), *pasang kesereep* (Djair), *keilmun*, *ogerie* (Muju), *linak-iong* (Manikiong), *matre* (Berak).

**50. *Hopea acuminata* MERR.** Philip. Gov. Lab. Bur. Bull. 29 (1905) 30; Philip. J. Sc. 1 (1906) Suppl. 98; En. Philip. 3 (1923) 93; WHITFORD, Philip. J. Sc. 4 (1910) Bot. 703; Bull. Bur. For. Philip. 10 (1911) 75; Foxw. Philip. J. Sc. 2 (1907) Bot. 389; *ibid.* 4 (1909) Bot. 514; *ibid.* 6 (1911) Bot. 264; *ibid.* 13 (1918) Bot. 183; REYES, Philip. J. Sc. 22 (1923) 339; SYM. Gard. Bull. S. S. 8 (1934) 22; GUTIERREZ, Act. Manil. 4, A, 2 (1968) 47, f. 9, pl. 5. — *H. maquilensis* Foxw. Philip. J. Sc. 13 (1918) Bot. 184. — **Fig. 64a.**

Medium-sized tree with flaky bark. Young parts fugaceous puberulent, panicle persistently so or glabrous, domatia and parts of petals exposed in bud persistently so. *Twig c.* 1 mm  $\varnothing$  apically, slender, much branched, terete, rugulose, dark brown. *Buds* minute; stipules fugaceous, not seen. *Leaves* 4.5–12 by 2–4.5 cm, elliptic-falcate to ovate-lanceolate, thinly coriaceous; base unequal, cuneate; acumen to 1 cm long, slender, tapering; nerves 9–11 pairs, slender but prominent beneath,  $\pm$  applanate above, arched, at 45°–65°, with (young trees) or without small axillary pubescent domatia; tertiary nerves densely scalariform, very slender, barely elevated beneath; *petiole* 6–8 mm long. *Panicle* to 3.5 cm long, slender, terminal or to 2-axillary, singly branched; branchlets bearing to 4 cream flowers; bracteoles fugaceous. *Flower buds* to 3 by 2 mm, ellipsoid. 2 outer *sepals* lanceolate-acuminate; 3 inner sepals suborbicular, mucronate. *Stamens* 10, equal; filaments compressed, tapering, rather broad; appendages aristate,  $1\frac{1}{2}$  times as long as the oblong anthers. *Ovary* and *stylopodium* broadly cylindrical, truncate, slightly tapering, densely puberulent; style shorter than ovary but prominent. *Fruit pedicel c.* 2 mm long, slender. 2 longer *calyx lobes* to 5.5 by 1 cm, spatulate, obtuse, *c.* 2 mm broad above the to 4 by 4 mm elliptic saccate thickened base; 3 shorter lobes to 3 by 2 mm, elliptic, similarly saccate.

*Nut* to 6 by 6 mm, broadly ovoid, with minute slender apical style remnant.

Distr. *Malesia*: Philippines.

Ecol. Widespread and common in semi-evergreen and evergreen forests, especially at 300–800 m but down to 100 m.

Vern. *Baniakau* (Ibn.), *barosingsing* (Ilk.), *dalingding* (Tag.), *dalingdingan* (Tag., S.L.Bis.), *kalar* (Ilk.), *manggachapui* (official and general name), *mangga-chinoro* (Tag.), *siayu* (S.L.Bis.), *yakal* (Tag.).

Note. Allied to the widespread *H. sangal* which it replaces in the Philippines.

**51. *Hopea depressinerva* ASHTON,** Gard. Bull. Sing. 22 (1967) 275, pl. 20; Man. Dipt. Brun. Suppl. (1968) 50, f. 7.

Medium-sized tree with slightly cracked bark. Young parts glabrescent. *Twig* 1–2 mm  $\varnothing$  apically, terete, smooth; stipule scars short, obscure. *Bud* to 1 by 1 mm, minute. *Stipule* unknown. *Leaves* 5–13 by 2–5 cm, lanceolate to narrowly elliptic, coriaceous, base cuneate; acumen to 1.5 cm long, slender; nerves 6–8 pairs, slender but raised beneath, depressed above, at 40°–50°; tertiary nerves slender, densely scalariform; midrib prominently terete beneath, slender, somewhat depressed, above; *petiole* 11–13 mm long, terete. *Panicle* to 7 cm long, terete, terminal or axillary, densely persistently buff pubescent; singly branched, branchlets to 1.5 cm long, bearing to 5 second flowers; *bracteoles* fugaceous, unknown. *Flower bud* to 3 by 2 mm, ellipsoid. *Calyx* densely buff sericeous, lobes ovate, acute, the outer 2 somewhat longer, relatively narrower, than the inner 3. *Petals* elliptic, obtuse, densely pubescent on parts exposed in bud, pink outside, pale orange within. *Stamens* 10, equal, forming a ring round the ovary; filaments broad, compressed at base, tapering and filiform below the subglobose anthers; appendages to connectives *c.* 2 times length of anthers, filiform, slender. *Ovary* and *stylopodium* glabrous, cylindrical, truncate, surmounted by a short style. *Mature fruit* unknown; *calyx lobes* unequal, the 2 longer aliform, considerably larger than the other 3.

Distr. *Malesia*: Borneo (W. Sarawak).

Ecol. Rare, granodiorite hill slopes below 500 m.

**52. *Hopea sangal* KORTH.** Kruidk. (1841) 75; WALP. Rep. 5 (1845) 128; Ann. 4 (1857) 339; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 34; MIQ. Fl. Ind. Bat. 1, 2 (1859) 504; DC. Prod. 16, 2 (1868) 635; SLOOT. ex HEYNE, Nutt. Pl. ed. 2 (1927) 1111; SYM. Gard. Bull. S. S. 8 (1934) 18, pl. 5; Mal. For. Rec. 16 (1943) 141, f. 68C, 69, 77; BROWNE, For. Trees Sarawak & Brunei (1955) 121; BACKER & BAKH. f. Fl. Java 1 (1963) 331; ASHTON, Gard. Bull. Sing. 20 (1963) 260; Man. Dipt. Brun. (1964) 108, f. 12, pl. 25 (bark); *ibid.* Suppl. (1968) 56; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 56, pl. 21b (stem), f. 31. — *Dryobalanops sericea* KORTH. Kruidk. (1841) 72; DC. Prod. 16, 2 (1868) 606; WALP. Rep. 5 (1845) 125. — *H. sericea* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 35; WALP. Ann. 4 (1857) 339;



MIQ. Fl. Ind. Bat. 1, 2 (1859) 504; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 85; DC. Prod. 16, 2 (1868) 635; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 238; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64; MERR. En. Born. (1921) 403. — *Petalandra micrantha* HASSK. Hort. Bog. Desc. (1852) 105; MIQ. Fl. Ind. Bat. 1, 2 (1859) 505; DC. Prod. 16, 2 (1868) 636; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 126. — *H. fafifolia* MIQ. Sum. (1862) 490; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7 (1868) 379; SCHEFF. Nat. Tijd. N. I. 31 (1870) 351; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 65; BOERL. Cat. Hort. Bog. 2 (1899) 103; K. & V. Bijdr. 5 (1900) 124; MOLL & JANSONIUS, Mikogr. Holz. (1906) 369; HEYNE, Nutt. Pl. 1, 3 (1917) 290; ed. 2 (1927) 1111; SYM. Gard. Bull. S. S. 7 (1933) 151, 154. — *H. diversifolia* (non MIQ.) SCHEFF. Nat. Tijd. N. I. 31 (1870) 351; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 239; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64; FOXW. Mal. For. Rec. 10 (1932) 123. — *H. odorata* (non ROXB.) HANCE, J. Bot. 5 (1876) 308, et auct. (1876–1927) p.p. *quoad syn.* *H. sangal*. — *Doona odorata* (ROXB.) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 233, p. *min. p.*, *quoad syn.* *H. sangal*. — *Doona micrantha* BURCK. l.c. 234. — *Doona javanica* BURCK, l.c. 235, t. 29, f. 7. — *Dryobalanops neglectus* KORTH. ex BURCK, l.c. 243, *nomen pro syn.* — *H. micrantha* [non (HASSK.) HOOK. f.] HEIM, Rech. Dipt. (1892) 64. — *H. hasskarliana* HEIM, l.c. 64. — *H. javanica* HEIM, l.c. 64; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64. — *H. curtisii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 124; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 65; BRÜHL & KING, Ann. Bot. Gard. Calc. 5, 2 (1896) 155, t. 187; BURK. J. Str. Br. R. As. Soc. 81 (1920) 66, fig.; RIDL. Fl. Mal. Pen. 1 (1922) 212, 236, fig.; FOXW. Mal. For. Rec. 10 (1932) 130; BURK. Dict. (1935) 1189. — *H. globosa* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 61; RIDL. J. Str. Br. R. As. Soc. 54 (1910) 26; Fl. Mal. Pen. 1 (1922) 236; HEYNE, Nutt. Pl. ed. 2 (1927) 1104; FOXW. Mal. For. Rec. 10 (1932) 121; BURK. Dict. (1935) 1190. — *H. lowii* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 63; RIDL. J. Str. Br. R. As. Soc. 73 (1916) 143; Fl. Mal. Pen. 1 (1922) 237; MERR. En. Born. (1921) 402; FOXW. Mal. For. Rec. 10 (1932) 123. — *H. minutiflora* C.E.C.FISCHER, Kew Bull. 1 (1927) 207; SMITINAND, Nat. Hist. Bull. Siam Soc. 19 (1958) 74. — *H. multiflora* (non BRANDIS) FOXW. Mal. For. Rec. 10 (1932) 110, p.p. — *H. albescens* (non RIDL.) FOXW. Mal. For. Rec. 10 (1932) 122. — **Fig. 15, 72 E1-E4.**

Medium-sized to large, dark flaky-barked, buttressed tree with prominent opaque white resin exudates on bole. Young twig, leaf bud, stipule, petiole, leaf undersurface, midrib above and panicle  $\pm$  sparsely pale grey-brown pubescent, leaf sometimes glabrescent. Twig to 1 mm  $\varnothing$  apically, slender, much branched, smooth. Bud to 2 mm long, ovoid. Stipule to 3 mm long, linear, fugaceous. Leaves 5.5–10 by 3.5–5 cm, ovate, thin, base  $\pm$  broadly cuneate; acumen to 1.2 cm long, caudate; nerves 10–12 pairs, slender, prominent beneath, slightly curved, at 50°–60°, with or without tomentose axillary domatia;

tertiary nerves very slender, scalariform, indistinct, oblique to nerves; midrib slender, prominent beneath.  $\pm$  applanate above; petiole 0.5–1 cm long. Panicle to 7 cm long, terminal or axillary, lax, terete; singly or doubly branched, branchlets bearing to 8 second flowers; bracteoles to 1 mm long, small, deltoid, buff pubescent. Flower buds very small, ellipsoid-ovoid. Calyx densely pubescent on both surfaces; 2 outer lobes deltoid, subacute, 3 inner lobes suborbicular, obtuse. Petals oblong-lanceolate, densely tomentose on parts exposed in bud, cream. Stamens 10; filaments slender, tapering; anthers oblong; appendage as long as anther, slender. Ovary and stylopodium short, broadly cylindrical, truncate, broader towards base, puberulent at apex; style  $\frac{2}{3}$  length of ovary and stylopodium, filiform, glabrous. Fruit calyx glabrescent; 2 longer lobes to 7 by 1.5 cm, oblong-spatulate, obtuse, tapering to 4 mm broad above the 5 by 4 mm somewhat saccate thickened base; 3 shorter lobes to 7 by 4 mm, obtuse. Nut to 7 by 4 mm, ovoid, persistently subtruncate at the short style remnant, sparsely pubescent.

Distr. Peninsular Thailand, and in *Malesia*: Malaya, Sumatra, Banka, Billiton, W. Java (rare), Lesser Sunda Is. (Bali, rare), Borneo.

Ecol. Locally common on clay rich soils on river banks; scattered on fertile clay hillsides to 500 m.

Vern. *Měrsiput*, *chengal pasir*, *c. mata kuching*, *damar siput*, *měrawan hitam* (Mal.), *gagil* (Sabah), *m. tēlor*, *m. batu*, *tongon banwah*, *chēngal*, *c. hitam*, *c. bunga*, *damar bintang*, *d. gēndiran*, *timbalun* (Sumatra), *awang awang*, *d. lampung*, *d. item*, *d. puteh*, *d. kunyit*, *lampung gunung*, *lantang arong*, *tēkam*, *t. paya* (Borneo).

**53. *Hopea ferrea* LANESS.** Pl. Util. Colon. Fr. 1 (1886) 300; PIERRE, For. Fl. Coch. 4 (1891) t. 249; HEIM, Rech. Dipt. (1892) 62; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1894) 262; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 61; GUÉRIN, Fl. Gén. I-C. 1 (1910) 371, 377, fig.; FOXW. Mal. For. Rec. 10 (1932) 126; BURK. Dict. (1935) 1189; SYM. Mal. For. Rec. 16 (1943) 124, f. 68H, 69. — *Balanocarpus anomalus* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 132; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 109; RIDL. Fl. Mal. Pen. 1 (1922) 247. — *H. anomala* FOXW. J. Mal. Br. R. As. Soc. 5 (1927) 340; Mal. For. Rec. 10 (1932) 126. — **Fig. 72 C-C4.**

Small, occasionally stout and large, shaggy-barked trees, often twisted and gnarled. Panicle and outside of petals and sepals densely buff puberulent, otherwise glabrous. Twig c. 1 mm  $\varnothing$ , slender, slightly zig-zag, drying dark brown, minutely rugulose; stipule scars obscure. Leaf bud minute; stipules fugaceous. Leaves 4–10 by 2–5.5 cm, ovate; base  $\pm$  broadly cuneate or rarely obtuse; acumen to 2 cm long, slender; nerves (6–)8(–9) pairs, arched, slender but distinctly raised beneath, evident above as also the midrib, frequently with minute glabrous axillary domatia; tertiary nerves densely scalariform, slender, evident beneath, obscure above; petiole 9–13 mm long, slender. Panicle to 8 cm



Fig. 73. *Hopea odorata* ROXB. *a*. Flowering branch, with domatia on leaves visible, *b*. leaf with infructescence, *c*. fruit, *d*. nut, all  $\times 2/3$  (*a* BKF 40492, the domatia from BKF 51769, *b* Cult. Hort. Bog. VIII-A-26, *c* Cult. Hort. Bog., sheet 902.146–395 in L).

long, slender, with to 3 cm long branchlets bearing many (to 12) secund cream flowers. *Flower bud* to 3 by 2 mm, small, ovoid. *Sepals* broadly ovate, subacuminate, subequal. *Stamens* 15, the filaments lorate but becoming filiform beneath the subglobose anthers; appendages somewhat shorter than anther. *Ovary* and *stylopodium* pyriform, glabrous; style short, obscure. *Fruit pedicel* to 2 by 1 mm, broadening into receptacle. 2 longer *calyx lobes* to 4 by 1 cm, broadly spatulate, obtuse, *c.* 2 mm broad above the to 3 by 1 mm minute thickened saccate base; 3 shorter lobes to 5 by 1 mm, lanceolate-acicular, thickened, saccate. *Nut* to 13 by 4 mm, cylindrical, tapering abruptly to a terminal apiculus.

Distr. Indochina, Thailand, and in *Malesia*: N. W. Malaya (Kedah, Perlis, Langkawi).

Ecol. Locally abundant on rocky ridges and slopes, especially on limestone.

Vern. *Malut* (Langkawi), *chěngal laki* (Kedah, Perlis).

**54. *Hopea odorata* ROXB.** [Hort. Beng. (1814) 42, *nomen*] Pl. Corom. 3 (1819) 7, t. 210; Fl. Ind. ed. Carey 2 (1832) 609; WALP. Rep. 5 (1845) 128; DYER, Fl. Br. Ind. 1 (1874) 308; PIERRE, For. Fl. Coch. 4 (1891) t. 244; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 59; Ind. Trees (1906) 67; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 373; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 292; TROUP, Silv. Ind. Trees 1 (1921) 47; CRAIB, Fl. Siam. Enum. 1 (1925) 147; LECOMTE, Bois Indochine (1926) 11; Foxw. Mal. For. Rec. 2 (1927) 75; *ibid.* 10 (1932) 118; BURK. Dict. (1935) 1192; CORNER, Wayside Trees 1 (1940) 212;



SYM. Mal. For. Rec. 16 (1943) 137, f. 69; SMITINAND, Thai For. Bull. 1 (1954) 18. — *H. vasta* WALL. [Cat. (1828) 962, *nomen*] ex DC. Prod. 16, 2 (1868) 633. — *H. decandra* BUCH.-HAM. ex WIGHT, Ill. Ind. Bot. 1 (1840) 88. — **Fig. 73.**

Tall buttressed tree with dark brown flaky bark. Twig apices sparsely fugaceous pale buff puberulent; panicle, leaf buds, flower calyx and petals outside densely persistently so; fruit calyx lobes and frequently nut glabrescent. *Twig* c. 2 mm  $\varnothing$  apically, terete, dark brown, smooth to rugulose; stipule scars pale, minute. *Buds* minute, ovoid; *stipules* minute, fugaceous. *Leaves* 7–14 by 3–7 cm, ovate-lanceolate, falcate; base broadly cuneate, unequal; acumens to 1.5 cm long, broad; nerves 9–12 pairs, prominent beneath, narrowly depressed above, arched, with prominent porous saccate axillary domatia; tertiary nerves densely sinuate-scalariform, very slender but clearly evident on both surfaces; midrib prominent beneath, appanate to somewhat channelled above; petiole 10–16 mm long, slender. *Panicle* to 12 cm long, terminal or axillary, twice-branched, with many to 2.5 cm long branchlets bearing to 9 secund flowers. *Flower buds* to 3 by 2 mm, broadly ovoid. Outer 2 sepals lanceolate, obtuse or subacuminate; inner 3 broadly ovate, acute. *Petals* pale cream-yellow. *Stamens* 15; filaments slender, compressed at base, tapering; appendage slender, as long as narrowly ellipsoid anthers. *Ovary* ovoid, punctate or glabrous, surmounted by an equally tall columnar style. *Fruit pedicel* to 1 mm long, short, slender. 2 longer *calyx lobes* to 5.5 by 2 cm,  $\pm$  broadly spatulate, obtuse, c. 3 mm broad above the to 4 by 4 mm small elliptic saccate base; 3 shorter lobes to 4 by 4 mm, ovate, subacuminate. *Nut* to 6 by 5 mm, small, ovoid, subobtuse.

Distr. Andamans, Burma, Thailand, Indochina and in *Malaysia*: Malaya (N. Perak & Trengganu northwards).

Ecol. Common, often gregarious, on river banks in Malaya.

Uses. Cultivated as a shade tree.

Vern. *Chēngal pasir*, *c. kampong*, *c. pulau*, *c. mas*.

Note. Allied to *H. parviflora* BEDD. of the Western Ghats, India.

**55. *Hopea centipeda*** ASHTON, Gard. Bull. Sing. 22 (1967) 274, pl. 19; Man. Dipt. Brun. Suppl. (1968) 48, pl. 11 (stem-base). — *H. acuminata* (non MERR.) ASHTON, Man. Dipt. Brun. (1964) 94. — **Fig. 72 D1–D4.**

Medium-sized, prominently stilt-rooted tree with smooth bark. Young twig, leaf bud, stipule (both surfaces), petiole, and nervation beneath densely shortly persistently brown pubescent. *Twig* to 1 mm  $\varnothing$  apically, branching horizontally, smooth, glabrous. *Bud* to 1.5 mm long, subglobose. *Stipule* to 3 mm long, linear. *Leaves* 5.5–9 by 1.5–3.5 cm, lanceolate; base unequal, cuneate; acumens to 1.5 cm long, caudate; nerves 7–9 pairs, prominent beneath, slightly curved, at 30°–40°, with prominent pilose axillary domatia; tertiary nerves slender, scalariform, with slight reticu-

lations, diagonal to nerves; midrib prominent, rounded beneath, narrow, depressed above; *petiole* 4–7 mm long, slender. *Panicle* to 2 cm long. *Flowers* cream; *bud* to 6 by 2 mm, lanceolate. *Calyx* sparsely pubescent; *sepals* ovate, acute, the outer 2 somewhat longer than the inner 3. *Stamens* 15, in unequal verticils; anthers subglobose; appendage to connective c. 3 times length of anthers, slender. *Ovary* and *stylopodium* pyriform, glabrous, surmounted by a prominent style equalling the stylopodium in length. *Fruit calyx* puberulent, glabrescent; 2 longer lobes to 2.8 by 0.6 cm, spatulate, obtuse, to 1.5 mm broad above the to 2.5 mm by 2 mm elliptic shallowly saccate thickened base; 3 shorter lobes to 4 mm long, obtuse, similar at base. *Nut* to 4 by 3 mm, ovoid, glabrous.

Distr. *Malaysia*: Borneo (Rejang hinterland to Lawas, S. E. Sabah).

Ecol. Local, on banks of fast flowing inland rivers.

Vern. *Mērawan daun bērbulu*.

**56. *Hopea plagata*** (BLCO) VIDAL, Sinopsis (1883) t. 15A; Rev. Pl. Vasc. Filip. (1886) 62; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64; MERR. Publ. Govt. Lab. Philip. 27 (1905) 22; MERRITT, Bull. Bur. For. Philip. 8 (1908) 48; WHITFORD, Philip. J. Sc. 4 (1910) 715; Bull. Bur. For. Philip. 10 (1911) 73; MERR. Sp. Blanc. (1918) 2691; En. Philip. 3 (1923) 94; REYES, Philip. J. Sc. 22 (1923) Bot. 447; GUTIERREZ, Act. Manil. 4, A, 2 (1968) 55, f. 11, pl. 7; ASHTON, Gard. Bull. Sing. 31 (1978) 32. — *Mocanera plagata* BLCO, Fl. Filip. ed. 1 (1837) 447. — *Dipterocarpus plagatus* BLCO, Fl. Filip. ed. 2 (1845) 311; *ibid.* ed. 3, 2 (1878) 212; DC. Prod. 16, 2 (1868) 614. — *Anisoptera plagata* BL. Mus. Bot. Lugd.-Bat. 2 (1856) 42; WALP. Ann. 4 (1867) 336; DC. Prod. 16, 2 (1868) 616. — *Shorea reticulata* (non THW. ex DYER) F.-VILL. Nov. App. (1880) 21. — *H. odorata* (non ROXB.) FOXW. Philip. J. Sc. 13 (1918) Bot. 183. — *H. sp. "Gyam"* FOXW. Philip. J. Sc. 6 (1911) Bot. 263. — *H. dasyrrachis* (non SLOOT.) ASHTON, Man. Dipt. Brun. Suppl. (1968) 49, f. 7. — **Fig. 72 A–A4.**

Large flaky barked buttressed tree. Parts entirely glabrous or ovary pubescent. *Twig* c. 1 mm  $\varnothing$  apically, much branched, terete, becoming smooth, dark brown. *Bud* c. 2 by 1 mm, ovoid, stipules fugaceous, not seen. *Leaves* 6–12 by 2.5–7 cm, elliptic-lanceolate to ovate,  $\pm$  falcate, coriaceous; base cuneate to obtuse,  $\pm$  markedly unequal; acumens to 1.5 cm long, tapering; nerves 8–11 (–12) pairs, slender, elevated beneath,  $\pm$  appanate above, ascending at 35°–65°, sometimes pale stellate lepidote beneath, usually with glabrous pore-like domatia; tertiary nerves densely scalariform, hardly elevated beneath; midrib  $\pm$  prominent on both surfaces; *petiole* 6–16 mm long. *Panicle* to 3 cm long, slender, 1-axillary or terminal, singly branched; branchlets to 2 cm long, bearing to 6 secund flowers; *bracteoles* fugaceous. *Flower bud* to 3 by 2 mm, ellipsoid, 2 outer sepals broadly ovate, subacute; 3 inner suborbicular, obtuse. *Stamens* c. 35, subequal, slightly shorter than style; filaments long, slender, narrowly compressed at base, tapering and

filiform in the distal  $\frac{1}{2}$ ; anther elongate, tapering; appendages  $\pm$  equal in length to anthers; acicular. *Ovary* ovoid, with obscure stylopodium and short broad style. *Fruit pedicel* to 2 mm long; 2 longer *calyx lobes* to 45 by 20 mm, broadly oblong-spatulate, sometimes suborbicular; 3 shorter lobes to 7 by 4 mm ovate. *Nut* to 10 by 7 mm, narrowly ovoid,  $\pm$  pubescent or glabrous.

Distr. *Malesia*: Philippines (Luzon, Mindoro, Tablas, Basilan, Tawitawi; rare in Mindanao); N. E. Borneo.

Ecol. Widespread and common in semi-evergreen seasonal forests, more local in evergreen non-seasonal forests, on limestone in Sarawak.

Uses. The most widespread heavy construction timber in the Philippines.

Vern. *Banutan* (Gad.), *batik* (Ilk.), *gisok gisok* (Bik.), *haras* (P. Bis.), *nutik* (Buk.), *paina* (Tag.), *pangian* (Ilk.), *saplingan*, *siakal* (Tag.), *siggai*, *s. na nalaboga*, *s. mulata*, *s. apuran* (Ilk.), *tagai* (Ilk. Neg.), *yakal* (Ilk., Pang., Sbl., Tag., Sul.), *yakal saplingan* (official name).

Note. Two flowering collections, LOHER 12914 and 14901 from Luzon, differ in possessing flowers with pubescent ovary and 15 stamens. They could, when more material is available, merit separation as a separate taxon, and serve to underline the close affinity of this species to *H. dasyrrhachis* SLOOT. (*q.v.*) whose distinct suborbicular fruit sepals occur sometimes in the present species; indeed sterile and fruiting collections from Sarawak attributed here to *H. dasyrrhachis* may in fact belong to *H. plagata*.

**57. *Hopea nutans*** RIDL. Fl. Mal. Pen. 1 (1922) 235; FOXW. Mal. For. Rec. 10 (1932) 123; BURK. Dict. (1935) 1191; SYM. Mal. For. Rec. 16 (1943) 136, f. 69, 76; BROWNE, For. Trees Sarawak & Brunei (1955) 125; ASHTON, Man. Dipt. Brun. (1964) 104, f. 12; *ibid.* Suppl. (1968) 54; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 217, f. 29. — *H. lowii* (non DYER) FOXW. Mal. For. Rec. 1 (1922) 67.

Medium-sized to large flaky-barked buttressed tree. Young twig, leaf bud, stipule, panicle and petiole very shortly sparsely pale brown pubescent. *Twig* to 2 mm  $\varnothing$  apically, much branched, smooth, becoming glabrous. *Bud* to 1.5 mm long, ovoid. *Stipule* to 2.5 mm long, linear, fugaceous. *Leaves* 8–13 by 4.5–8.5 cm, broadly ovate, coriaceous, greyish lepidote below in mature tree; base obtuse; acumen to 1 cm long; margin frequently slightly revolute; nerves 7–10 pairs, distinct, hardly raised beneath, curved, at 50°–60°, usually with large glabrous swollen pore-like domatia; tertiary nerves slender but distinct, scalariform with slight reticulations, diagonal to nerves; midrib broad, slightly raised on both surfaces; *petiole* 1–1.5 cm long. *Panicle* to 7 cm long, terminal or axillary, terete or angular; singly branched, branchlets to 1.5 cm long, bearing to 5 secund pale yellow flowers; *bracteoles* to 3 mm long, hastate, subacute. *Flower bud* to 4 by 2.5 mm, broadly ellipsoid, obtuse. *Calyx* densely pubescent outside, glabrous within; 2 outer lobes hastate,

subacute; 3 inner lobes broadly ovate, thinner, tapering at base. *Petals* linear, puberulent on parts exposed in bud. *Stamens* 15, in 3 subequal whorls; filaments broad at base, tapering and filiform below anthers; anthers subglobose, tapering apically; appendage to connective *c.* 2 times length of anther, slender, scabrous towards apex. *Ovary* and *stylopodium* subcylindrical, glabrescent; style short, glabrous. *Fruit calyx* sparsely pale brown pubescent or glabrescent; 2 longer lobes to 8 by 1.5 cm, oblong, thinly coriaceous, broad, obtuse, tapering to the to 2.5 by 3 mm ovate saccate thickened base; 3 shorter lobes to 10 mm long, acute, similar at base. *Nut* to 15 by 8 mm, ovoid, glabrous; style remnant, short, acute.

Distr. *Malesia*: Malaya (E. coast from Trengganu southwards), Borneo (Sarawak, Sabah, Nunukan).

Ecol. Sandy soils, often periodically swampy, near and on coastal hills.

Vern. *Giam*, *chëngal*, *c. batu*, *c. këräs*, *c. pëlandok*, *tëngkawang* (Mal.), *garang buaya daun këchil* (Brun.).

**58. *Hopea bancana*** (BOERL.) SLOOT. Reinwardtia 3 (1956) 317. — *Balanocarpus bancanus* BOERL. Cat. Hort. Bog. (1901) 111.

Medium-sized flaky-barked hard-wooded tree. Twigs, petiole, midrib above and calyx outside caducous buff pubescent, persistent in young trees and on parts of petals exposed in bud and leaf buds. *Twig* *c.* 2 mm  $\varnothing$  apically, terete, rugulose, blackish. *Bud* minute; *stipules* not seen. *Leaves* 8–15 by 3.5–7.5 cm, ovate-falcate, thinly coriaceous, lustrous; base  $\pm$  broadly cuneate to obtuse, frequently shortly decurrent; unequal; acumen to 1.5 cm long, tapering; nerves 6–8 pairs, slender but distinctly elevated on both surfaces (more so below) as also the midrib, arched, at 45°–60°, with prominent glabrous porous canaliculate domatia (absent in immature trees); tertiary nerves densely scalariform, very slender,  $\pm$  elevated on both surfaces; *petiole* 11–14 mm long (shorter in young trees), slender. *Panicle* to 8 cm long, slender, pendant, to 2-axillary or terminal, singly branched; branchlets to 2 cm long, bearing to 5 flowers; *bracts* fugaceous. *Flower bud* to 3 by 2 mm, ellipsoid. 2 outer *sepals* ovate, acute, 3 inner ovate, acuminate. *Stamens* 15, in 3 unequal verticils; filaments compressed but rather narrow at base, tapering to the narrowly ellipsoid subacute anthers; appendage as long as anthers, relatively stout. *Ovary* and *stylopodium* stoutly pyriform, subtruncate, with short columnar style. *Fruit pedicel* *c.* 2 mm long, stout. 2 longer *calyx lobes* to 9 by 2.5 cm, lorate, obtuse, *c.* 5 mm broad and subrevolute above the *c.* 5 by 5 mm broadly ovate saccate thickened base; 3 shorter lobes to 6 by 6 mm, ovate, acute, similarly saccate. *Nut* to 9 by 6 mm, ovoid, shortly apiculate, resinous.

Distr. *Malesia*: Central W. Sumatra (P. Musala).

Ecol. Very rare, low hills.

Note. Most collections come from a tree in Kebun Raya Indonesia, the provenance of which was said to be Banka, though no collections exist from that island.



**59. *Hopea pentanervia*** SYM. ex WOOD, Gard. Bull. Sing. 17 (1960) 495; BROWNE, For. Trees Sarawak & Brunei (1955) 126; ANDERSON, Gard. Bull. Sing. 20 (1963) 157; ASHTON, Man. Dipt. Brun. (1964) 106, f. 12, pl. 31 (bark); *ibid.* Suppl. (1968) 55; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 219, f. 30.

Medium-sized, flaky-barked buttressed tree. Young parts puberulent, glabrescent. *Twig* to 1.5 mm  $\varnothing$  apically, terete, much branched, smooth. *Bud* to 1.5 mm long, small. *Stipule* to 2 mm long, linear, fugaceous. *Leaves* 5–10 by 3.2–5 cm ovate, coriaceous; base obtuse or broadly cuneate; acumen tapering, to 1.5 cm long, narrow, margin slightly revolute; nerves c. 5 pairs, prominent beneath, slender, at  $45^{\circ}$ – $55^{\circ}$  but strongly curved, with small glabrous pore-like domatia; tertiary nerves slender, distinct, densely scalariform, at  $90^{\circ}$  to midrib; midrib slender, raised beneath,  $\pm$  applanate above; *petiole* 6–11 mm long. *Panicle* to 8 cm long, terminal or to 2-axillary, terete, lax; regularly singly or doubly branched, branchlets to 1.5 cm long, bearing to 6 second flowers; *bracteoles* small, narrowly deltoid, glabrous, caducous. *Flower bud* small, ellipsoid, on c. 1.5 mm long pedicel. *Calyx* glabrous but for fimbriate margin; 2 outer lobes oblong, acute; 3 inner lobes short, ovate, acuminate. *Petals* narrowly lanceolate, shortly pubescent on parts exposed in bud. *Stamens* 15, small, well spaced round the ovary; filaments broad at base, tapering abruptly and filiform distally; anthers subglobose; appendage to connective c. 3 times length of anthers, very slender. *Ovary* and *stylopodium* cylindrical, truncate, glabrous; style short, abrupt, slender. *Fruit calyx* glabrous; 2 longer lobes to 5 by 1.2 cm, spatulate, chartaceous, obtuse, to 3 mm broad above the to 3 by 3 mm small ovate saccate somewhat thickened base; 3 shorter lobes to 4 by 3 mm, ovate, acute, saccate. *Nut* to 4 by 3.5 mm, ovate, glabrous; style remnant short.

Distr. *Malesia*: Borneo (Sarawak to W. Sabah, Sandakan).

Ecol. Mixed peat swamp forest over sand, podsols on cuetas, plateaux and terraces, near present or Pleistocene coastlines; on ultrabasic rocks in E. Sabah.

Vern. *Sĕlangan lima urat* (Sabah), *mang, m. bĕsi* (Sar.), *chĕngai paya* (Iban).

**60. *Hopea basilanica*** FOXW. Philip J. Sc. 6 (1911) Bot. 260, pl. 42; *ibid.* 13 (1918) 183; MERR. En. Philip. 3 (1923) 93; GUTIERREZ, Act. Manil. 4, A, 2 (1968) 53, f. 10, pl. 6.

Tall, flaky-barked, hard-wooded tree. Young twig, petiole, midrib above, panicle, calyx and corolla outside and ovary greyish cinereous, persisting only on corolla outside. *Twig* 1–2 mm  $\varnothing$  apically, terete, much branched, dark brown. *Leaves* (7.5–)10–14 by (2.5–)3.5–5 cm, oblanceolate or elliptic, thickly coriaceous; base cuneate, unequal; acumen to 15 mm long, prominent, slender; nerves (9–)10–13 pairs, slender but prominent beneath, applanate above, with prominent glabrous pore-like domatia in the axils of the

basal 2–3 pairs; tertiary nerves scalariform, evident but hardly elevated on either surface; *petiole* 6–10 mm long, short. *Panicles* to 7 cm long, to 3 axillary or ramiflorous, slender, singly branched; branchlets to 17 mm long, bearing to 7 second flowers. *Flower bud* to 3 by 2 mm, very small. *Sepals* ovate, the outer 2 subacute, the inner 3 shortly slender-acuminate. *Stamens* 15, in 3 unequal verticils; filaments compressed, broad at base, tapering in the distal  $\frac{1}{2}$  and filiform beneath the subglobose anthers; appendage slender, filiform, c.  $2\frac{1}{2}$  times length of anthers. *Ovary* and *stylopodium* equal in length, together broadly hour-glass shaped with a distinct median constriction; style as long as ovary, columnar, slightly tapering. *Fruit pedicel* c. 1 mm long, short, slender. 2 longer calyx lobes to 4.5 by 1.5 cm, broadly spatulate, obtuse, chartaceous, c. 4 mm broad above the 2–6 by 5 mm elliptic saccate base; 3 shorter lobes to 7 by 5 mm, ovate, acute. *Nut* to 6 by 5 mm, small, ovoid, shortly apiculate.

Distr. *Malesia*: Philippines (Basilan, Mindanao).

Ecol. Undulating land and hills below 70 m.

Uses. Locally used for construction.

**61. *Hopea andersonii*** ASHTON, Gard. Bull. Sing. 22 (1967) 272, pl. 17; Man. Dipt. Brun. Suppl. (1968) 46, f. 6.

**a. ssp. *andersonii*.**

Medium-sized tree to 40 m tall, with chocolate-brown thickly flaky bark. Vegetative parts glabrous. *Twigs* c. 1 mm  $\varnothing$  apically, terete, smooth; stipule scars short, obscure. *Bud* to 1 by 1 mm, subglobose. *Stipule* unknown. *Leaves* 5–14 by 2–6 cm, lanceolate-falcate to elliptic, coriaceous, drying tawny with the nervation beneath dark red-brown; base obtuse on adaxial side, cuneate on the other, unequal; acumen to 2 cm long, slender, frequently falcate; nerves 9–12 pairs, slender, not prominently raised, arched, at  $65^{\circ}$ – $75^{\circ}$ , some with prominent axillary pustular pored domatia; tertiary nerves scalariform; midrib evident but unraised or hardly so above, prominent beneath; *petiole* 5–10 mm long. *Panicle* to 12 cm long, terminal or axillary, terete, frequently fascicled, densely evenly  $\pm$  persistently pale grey puberulent; singly branched, branchlets bearing to 9 second flowers; *bracteoles* to 2 mm long, linear, puberulent, fugaceous. *Flower bud* to 3 by 2 mm, ellipsoid. *Sepals* ovate, acute, subequal, densely pubescent outside, more sparsely so within. *Petals* lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the broadly ellipsoid anthers; appendage to connective slender, 2– $2\frac{1}{2}$  times as long as anther. *Ovary* and *stylopodium* cylindrical, very slightly constricted medially, the stylopodium slightly narrower than the ovary, both densely papillose and puberulent; style short, columnar. *Fruit pedicel* to 3 mm long, slender. 2 longer calyx lobes to 6 by 2 cm, oblong, obtuse, puberulent at base but otherwise glabrous, to c. 3 mm broad above the to 4 by 3 mm elliptic somewhat

thickened saccate base; 3 shorter lobes to 4 by 3 mm, ovate, obtuse, saccate. *Nut* to 8 by 5 mm, ovoid, glabrous, with a small apical truncate stylopodium and *c.* 1 mm long mucronate style remnant.

Distr. *Malesia*: Borneo (W. and N.E. Sarawak).

Ecol. Common on the lower slopes of limestone hills, to 400 m.

Vern. *Luis somit*.

**b. ssp. basalticola** ASHTON, Gard. Bull. Sing. 22 (1967) 272.

Bark surface coppery-brown, thinly flaked. Leaf drying pale grey-brown.

Distr. *Malesia*: Borneo (Central and N.E. Sarawak, E. Sabah, S.E. Borneo to Pleihari, Ulu Kapuas).

Ecol. Mixed Dipterocarp forest on clay rich soils, especially on basic volcanic rocks; to 400 m.

**62. Hopea ovoidea** ASHTON, Gard. Bull. Sing. 31 (1978) 34. — *H. plagata* [non (BLCO) VIDAL] FOXW. Philip. J. Sc. 3 (1907) Bot. 396, *p.p.*; *ibid.* 4 (1909) Bot. 515; *ibid.* 6 (1911) Bot. 262, 285; *ibid.* 13 (1918) Bot. 183; *ibid.* 67 (1938) 278, *p.p.*

Large buttressed flaky-barked tree. Leaf bud, panicle, parts of perianth exposed in bud, and ovary densely persistently pale buff pubescent, parts otherwise glabrescent. *Twigs c.* 1 mm  $\varnothing$  apically, slender, becoming terete, smooth or rugulose. *Buds* minute; stipule unknown, fugaceous. *Leaves* 9–13 by 3–6.5 cm, elliptic to narrowly ovate, chartaceous and undulate on drying; base  $\pm$  equal, cuneate,  $\pm$  shortly decurrent; acumen to 2 cm long, slender, tapering; nerves 7–8 (to 10 in young trees) pairs, slender but distinctly elevated beneath, arched, ascending at 65°–55°, without or with a few porous canalliculate domatia; tertiary nerves scalariform,  $\pm$  distinctly elevated beneath; *petiole* 10–15 mm long, slender. *Panicle* to 13 mm long, erect, slender, to 2-axillary or terminal, singly branched; branchlets to 3.5 cm long, bearing to 7 second flowers; *bracteoles* fugaceous. *Flower buds* to 3 by 2 mm, ovoid; 2 outer *sepals* narrowly deltoid, subacute; 3 inner *sepals* broadly ovate, acute; *stamens* 15, in 3 subequal verticils; filaments compressed at base, tapering to the narrowly elliptic subacute anthers; appendage  $1\frac{1}{2}$ –2 times length of anther, acicular, relatively stout; *ovary* and *stylopodium* ovoid, surmounted by a short glabrous columnar style *c.*  $\frac{1}{2}$  their length. *Fruit* unknown.

Distr. *Malesia*: N.E. Borneo (Sandakan to Tawau).

Ecol. Low hills near coast. Rare.

Notes. LOHER 12914 & 14901, from Luzon, confused by FOXWORTHY with *H. plagata* VIDAL, appear to belong to this species, though the leaves are narrower and the nerves less prominent beneath.

*H. ovoidea* closely resembles *H. semicuneata* SYM. when sterile, but can nevertheless be distinguished by its brown, rather than grey-brown, drying leaves and small, canalliculate rather than pustular domatia which are at times absent; the pubescent ovoid ovary

and rather stout connectival appendages (slender and thrice as long as the anthers in *H. semicuneata*) define this species.

**63. Hopea semicuneata** SYM. Gard. Bull. S. S. 8 (1934) 24, pl. 6; Mal. For. Rec. 16 (1943) 143, f. 69; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 224, f. 32; ASHTON, Man. Dipt. Brun. Suppl. (1968) 56, f. 8. — *H. sp.* SLOOT. ex MERR. Pl. Elm. Born. (1929) 202. — *H. diversifolia* MIQ. Sum. (1860) 491, *p.p.*; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7 (1868) 379. — '*Samarupa chengal*' FOXW. Mal. For. Rec. 10 (1932) 71, *p.p.* — *H. multiflora* (non BRANDIS) FOXW. Mal. For. Rec. 10 (1932) 119, *p.p.* — *H. plagata* (non VIDAL) SYM. Gard. Bull. S. S. 7 (1933) 154.

Tall flaky-barked and buttressed tree. Young twigs and petioles fugaceous puberulent, vegetative parts otherwise glabrous. *Twig c.* 1 mm  $\varnothing$  apically, terete, becoming striated. *Bud* to 2 by 1 mm, conical. *Stipule* to 2 mm long, linear, fugaceous. *Leaves* 6.5–14 by 2–7 cm, elliptic to ovate-lanceolate, chartaceous, frequently undulate; base narrowly or broadly cuneate; acumen to 2.5 cm long, slender, tapering; nerves 6–9 pairs, scalariform, depressed above, slender but prominent beneath, set obliquely at 45°–65°, frequently with prominent, pustular domatia; tertiary nerves densely scalariform, at 90° to the midrib; midrib slightly raised to slightly depressed above,  $\pm$  prominent beneath; *petiole* 6–12 mm long, slender. *Panicle* to 7 cm long, terminal or axillary, terete, densely shortly evenly persistently pale cream-buff pubescent; singly branched, the branchlets bearing to 7 cream flowers; *bracteoles* to 1 mm, short, deltoid, fugaceous. *Flower bud* to 2 by 1 mm, ellipsoid. *Sepals* broadly ovate, acute, subequal, glabrous or pubescent. *Petals* lanceolate, puberulent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering filiform below the ellipsoid anthers; appendage to connective slender, *c.* 3 times length of anther, reaching almost to style apex. *Ovary* and *stylopodium* cylindrical, truncate, sometimes constricted medially, glabrous but for the papillose apical platform; style shortly columnar, glabrous. *Fruit calyx* at first pale buff puberulent, caducous except at base. *Pedicel* to 2 mm long. 2 longer *calyx lobes* to 9.5 by 2.2 mm, broadly lorate, obtuse, *c.* 4 mm wide above the 8 by 6 mm elliptic thickened saccate base; 3 shorter lobes to 4 by 6 mm, broadly ovate, subacute, saccate. *Nut* to 6 by 5 mm, subglobose, shortly apiculate.

Distr. *Malesia*: Malaya, Sumatra (Atjeh, Lampung), Borneo.

Ecol. Local, clay rich alluvium, undulating land, and hillsides below 500 m.

Vern. *Sama rupa chëngal*, *chëngal*, *c. batu*, *c. mas*, *pënak*, *p. batu* (Mal.), *giam kulit mërak* (Sabah).

**64. Hopea megacarpa** ASHTON, Gard. Bull. Sing. 22 (1967) 278, pl. 24; Man. Dipt. Brun. Suppl. (1968) 53, f. 7.

Small or medium-sized smooth-barked tree. Young



twig, petiole and leaf nervation beneath sparsely caducous puberulent, leaf bud persistently so. *Twig* c. 1 mm  $\varnothing$  apically, slender, terete, smooth; stipule scars small, obscure. *Bud* to 1 by 1 mm, minute. *Stipule* to 2 mm long, linear-falcate, caducous. *Leaf* 6–12 by 1.5–5 cm,  $\pm$  narrowly elliptic, thinly coriaceous, undulate, with cuneate base and to 2 cm long prominent caudate acumens; nerves 6–7 pairs, slender, raised beneath, at 25°–40°; tertiary nerves slender, densely scalariform; midrib prominent, terete beneath, appanate to slightly raised, slender, above; *petiole* c. 6 mm long, short, grooved on upper side. *Panicle* to 3 cm long, axillary, terete, glabrous, lax; singly branched, branchlets bearing to 3 flowers; *bracts* and *bracteoles* to 2 mm long, linear. *Flower bud* 4 by 3 mm, subglobose. *Calyx lobes* fimbriate; 2 outer lobes ovate, acute; 3 inner lobes suborbicular, submucronate. *Petals* elliptic-oblong, obtuse, sparsely puberulent on parts exposed in bud, pale pink. *Stamens* 15; filaments broad at base, tapering and filiform distally; anthers oblong; appendage to connective c. 3 times length of anthers, slender, filiform. *Ovary* and *stylopodium* cylindrical, subtruncate, glabrous, surmounted by a short style. *Fruit* entirely glabrous. *Pedicle* to 3 mm long, broadening into fruit. 2 longer *calyx lobes* to 10 by 1.3 cm, narrowly spatulate, subacute, c. 5 mm wide above the to 9 by 15 mm subauriculate saccate base; 3 shorter lobes to 20 by 9 mm, ovate, similarly subauriculate, enclosing and obscuring the nut. *Nut* to 12 by 10 mm, ovoid, with minutely truncate mucronate apex.

Distr. *Malesia*: N.W. Borneo (Central Sarawak; W. and S.E. Kalimantan).

Ecol. Locally frequent in Mixed Dipterocarp forests below 600 m in the Rejang hinterland.

**65. *Hopea samarensis* GUTIERREZ, Kalikasan 4 (1975) 236, f. 1.**

Small smooth-barked tree. Parts glabrous but for the pubescent domatia and parts of petals exposed in bud, and glabrescent sepals. *Twigs* c. 2 mm  $\varnothing$  apically, slender. *Leaves* (4–)8–15 by (1.5–)3–5.5 cm, oblong-elliptic, thinly coriaceous; acumens to 1 cm long, subcaudate; base subequal, cuneate; nerves 9–12(–13) pairs, slender but prominent beneath, evident above, with small axillary domatia; tertiaries densely scalariform, very slender, evident beneath; petiole 8–12 mm long, slender. *Panicles* to 4 cm long, singly branched, to 3-ramiflorous; branchlets to 2 cm long, bearing to 4 second flowers; bracteoles minute, deltoid, fugaceous. *Flower bud* to 8 by 4 mm, ovoid; sepals broadly ovate, the inner 3 acute, the outer 1 acuminate, becoming rotate before anthesis; *petals* lorate; stamens 15 in 3 unequal verticils; filaments broad at base, tapering and filiform beneath the broadly ellipsoid anthers; appendage aristate, c. 2–3 times length of anthers; *ovary* ovoid, surmounted by a slightly shorter slender cylindrical tapering stylopodium with short terminal style c.  $\frac{1}{2}$  its length. *Fruit* unknown.

Distr. *Malesia*: Philippines (Samar I.).

Ecol. Locally common in moist lowland valleys in Mixed Dipterocarp forest.

**66. *Hopea nodosa* SLOOT. Reinwardtia 2 (1952) 25, f. 8; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 38.**

Medium-sized tree with flaky bark and steep buttresses. Parts glabrous but for the persistently pubescent parts of the petals exposed in bud. *Twigs* 2–3 mm  $\varnothing$ , rather stout, terete; *buds* and *stipules* not seen. *Leaves* (6–)8–20 by (2.5–)3.8–7 cm, elliptic, coriaceous, lustrous, minutely punctate above; margin narrowly revolute; base broadly cuneate; acumens to 1 cm long, tapering; nerves 8–11 pairs, prominent beneath, elevated but frequently set in a groove above, arched, ascending at 50°–70°; domatia minute, porous, or absent; without secondaries; tertiary nerves scalariform, obscure; midrib prominent beneath, distinctly elevated above; *petiole* 7–15 mm long, rather stout. *Panicle* to 4 cm long, slender, terminal or to 2-axillary or ramiflorous; singly branched, branchlets to 12 mm long, bearing to 6 flowers; *bracteoles* fugaceous, not seen. *Flower buds* to 3 by 2 mm, ellipsoid. *Sepals* subequal, broadly ovate-deltoid, obtuse. *Stamens* 15, shorter than style, in 3 unequal verticils; filaments broad and compressed at base, tapering and filiform in the distal  $\frac{1}{2}$ ; anthers subglobose; appendages c. twice as long as anthers, slender. *Ovary* and *stylopodium* narrowly pyriform with distinct medial constriction, tapering to the short but distinct columnar style. *Fruit* subsessile; *calyx lobes* to 7 by 8 mm, subequal, shorter than nut, broadly ovate, subacute, saccate, thickened. *Nut* to 10 by 6 mm, ovoid, shortly apiculate.

Distr. *Malesia*: N.W. New Guinea (Beriat, Teminabuan; Sorong).

Ecol. Locally common in secondary and primary lowland forest.

Vern. *Megun gun* (Telid).

**67. *Hopea celebica* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 237; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64; HEYNE, Nutt. Pl. ed. 2 (1927) 1110; SLOOT. Reinwardtia 2 (1952) 15, f. 5; BACKER & BAKH. f. Fl. Java 1 (1963) 331; ASHTON, Gard. Bull. Sing. 31 (1978) 35. — *H. dolosa* SLOOT. Reinwardtia 2 (1952) 18, f. 6.**

Medium-sized, hard-wooded, scaly-barked tree. Twig apices, petiole, panicle and calyx outside  $\pm$  caducous buff pubescent, parts of petals exposed in bud and sometimes panicle persistently so. *Twigs* c. 2 mm  $\varnothing$  much branched, terete, smooth. *Buds* small, ovoid; *stipules* not seen. *Leaves* (5.5–)8–22 by (2.2–)2.5–8 cm, ovate-lanceolate, coriaceous,  $\pm$  lustrous; margin  $\pm$  revolute; base subequal, obtuse or sometimes broadly cuneate; acumens to 1.5 cm long, usually short, tapering; nerves 8–11 pairs, slender but prominent beneath, slightly elevated above, arched, at 45°–55° except at base, often with prominent axillary porous canaliculate domatia; tertiary nerves subscleriform, evident on both surfaces though more distinct beneath; midrib prominent beneath, distinctly elevated above; *petiole* 10–16 cm long. *Panicle* to 9 cm long, terminal, to 3-axillary or ramiflorous, slender, pendant, singly branched; branchlets to 13 mm long,

short, bearing to 4 flowers; *bracteoles* minute, deltoid, fugaceous. *Flower buds* to 2 mm long, ellipsoid. 2 outer *sepals* long, narrowly deltoid-lanceolate; 3 inner broadly ovate,  $\pm$  distinctly acuminate. *Stamens* 15, in 3 subequal verticils, short; filaments broad and compressed at base, tapering and filiform beneath the oblong anthers; appendages c.  $1\frac{1}{2}$  times length of anther, slender. *Ovary* and *stylopodium* stoutly pyriform, *stylopodium* punctate; style short but distinct, columnar. *Mature fruit* unknown; *pedicel* at least 3 mm long; *sepals* unequal, 2 aliform, spatulate, obtuse; 3 shorter lobes exceeded by the ovoid apiculate nut.

Distr. *Malesia*: Celebes (S.W. Peninsula: Maros; Central: Malili).

Ecol. Locally common in semi-evergreen forest below 500 m.

Uses. Construction.

Vern. *Hulo dereh*, *kërih* (Maros), *hulodere*, *damar derehitëm*, *d.d. lotang*, *bisik bisik*, *rinni rinni*, *sarëh parëh*, *torinih* (Malili).

**68. *Hopea iriana*** SLOOT. *Reinwardtia* 2 (1952) 28, f. 10; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 35; ASHTON, Gard. Bull. Sing. 31 (1978) 35. — *H. nabirensis* SLOOT. *Reinwardtia* 2 (1952) 27, f. 9; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 38.

Tall, hard-wooded tree with blackish flaky bark and flying buttresses. Young parts buff puberulent, becoming sparse but  $\pm$  persistent on calyx, persistent on panicle and parts of petals exposed in bud. *Twig* c. 2 mm  $\varnothing$  apically, much branched, terete, becoming smooth, blackish. *Leaf bud* minute, ovoid; *stipules* fugaceous, not seen. *Leaves* 5–13 by 2–4.5 cm, lanceolate-falcate, coriaceous, dull greyish minutely stellate beneath; margin frequently subrevolute; base unequal, cuneate; acumen to 1.5 cm long, slender, tapering; nerves 7–11 pairs, slender but distinctly elevated beneath, slightly elevated above, usually with prominent porous glabrous canaliculate domatia; tertiary nerves scalariform, evident on both surfaces,  $\pm$  distinctly elevated beneath; *petiole* 7–9 mm long, slender. *Panicle* to 6 cm long, slender, terminal or 1-axillary; singly branched, branchlets to 1.5 cm long, bearing to 5 dense secund flowers; *bracteoles* fugaceous, not seen. *Flower buds* to 3 by 2 mm, ellipsoid. 2 outer *sepals* narrowly lanceolate, subacute; 3 inner suborbicular, mucronate. *Stamens* 15, shorter than style, in 3 subequal verticils; filaments broad and compressed at base, tapering and filiform in the distal  $\frac{1}{2}$ ; anthers broadly oblong; appendage c. 3 times length of anthers, long, slender. *Ovary* and *stylopodium* conical-cylindric, sericeous, tapering somewhat abruptly beneath the short but distinct columnar style. *Fruit pedicel* to 2 mm long, 2 longer *calyx lobes* to 7 by 1.8 cm, broadly spatulate, obtuse, c. 4 mm broad above the 6 by 4 mm ovate saccate thickened base; 3 shorter lobes to 6 by 4 mm, ovate, acute, similarly saccate. *Nut* to 13 by 7 mm, ovoid, with tapering apiculus.

Distr. *Malesia*: New Guinea (West: Manokwari

area, Hollandia; Papua New Guinea: Morobe Distr.), Japen I.; Aru Is. (sterile collections only).

Ecol. Evergreen forests; widespread hills below 600 m, especially on ridges.

Vern. *Sian*, *saindori* (Japen), *lilipga* (Manikiong).

Notes. A variable species which, as *H. novoguineensis*, appears to possess regional diversification; collections from western New Guinea have notably larger more lustrous leaves.

**69. *Hopea glabrifolia*** C.T. WHITE, Proc. R. Soc. Queensl. 43 (1932) 49; SLOOT. *Reinwardtia* 2 (1952) 35, f. 13; v. ROYEN, Man. Forest Trees Papua New Guinea 8 (1965) 35.

Tall, buttressed tree with hard wood and flaky bark. Young parts and panicle greyish puberulent, glabrescent; petals persistently puberulent on parts exposed in bud. *Twig* c. 2 mm  $\varnothing$  apically, ribbed, much branched, becoming terete, rugose, dark brown. *Leaf buds* minute, ellipsoid; *stipules* not seen, fugaceous. *Leaves* 18–19 by 2–5.5 cm, lanceolate, falcate, coriaceous, lustrous; margin narrowly subrevolute; base prominently unequal, cuneate abaxially, cordate adaxially; acumen to 1.5 cm long, broad, tapering; nerves 9–12 pairs, slender but prominent beneath,  $\pm$  narrowly depressed above, arched, ascending at 45°–50° except at base; without secondaries; tertiaries densely scalariform, very slender but distinctly elevated beneath; midrib prominent beneath, slender but prominent above; *petiole* 5–8 mm long, short. *Panicles* to 5 cm long, terminal or to 3-axillary, slender; singly branched, branchlets to 1.5 cm long, bearing to 5 flowers. *Flower buds* to 3 by 2 mm, ellipsoid. *Sepals* ovate to suborbicular, subacute. *Stamens* 15; appendage c. 4 times the length of the anther cells. *Gynoeceum* glabrous; ovary ovoid, surmounted by a cylindrical *stylopodium* twice its length and very short style. *Fruit pedicel* c. 1 mm long, short. 2 longer *calyx lobes* to 7 by 1.3 cm, spatulate, obtuse, c. 3 mm broad above the to 8 by 6 mm ovate saccate thickened base; 3 shorter lobes to 9 by 7 mm, ovate, acute. *Nut* to 14 by 8 mm, ovoid, stoutly apiculate.

Distr. *Malesia*: Papua New Guinea (Milne Bay area) and Louisiades (Sudest I., Misima I.).

Ecol. Locally abundant in semi-evergreen seasonal forest below 350 m.

Vern. *Kapilatana*, *matapo*, *malabia*.

**70. *Hopea gregaria*** SLOOT. *Reinwardtia* 2 (1952) 21, f. 7; ASHTON, Gard. Bull. Sing. 31 (1978) 32.

Medium-sized or large flaky-barked tree with hard wood. Young parts buff puberulent, becoming sparse but  $\pm$  persistent on calyx, persistent on panicle and parts of petals exposed in bud. *Twig* 1–2 mm  $\varnothing$  apically, much branched, terete, becoming smooth, blackish. *Leaf bud* minute, ovoid; *stipules* fugaceous, not observed. *Leaf* 6–13 by 2.5–6.5 cm, lanceolate-falcate to ovate, thinly coriaceous, with dull minutely stellate undersurface; base cuneate, unequal; acumen to 1.5 cm long, slender, tapering; nerves 7–10 pairs, slender but distinctly elevated beneath,  $\pm$  applanate



above, rarely with glabrous porous canaliculate axillary domatia; tertiary nerves scalariform,  $\pm$  evident on both surfaces; midrib slender but prominent beneath, evident and  $\pm$  elevated above; *petiole* 6–10 mm long, slender. *Panicle* to 6 mm long, slender, terminal or 1-axillary, singly branched, branchlets to 12 mm long, bearing to 4 flowers. *Flower buds* to 3 by 2 mm, ellipsoid. *Sepals* subequal, ovate, acute. *Stamens* 15, shorter than style, in 3 subequal verticils; filaments broad, compressed, tapering and becoming filiform below the broadly oblong anthers; appendages c.  $1\frac{1}{2}$

times length of anthers. *Ovary* and *stylopodium* broadly pyriform, punctate distally, somewhat abruptly tapering to the short columnar style. *Mature fruit* unknown. *Pedicels* c. 3 mm long; *sepals* unequal but the 2 longer relatively short, broad, becoming reflexed; nut ovoid, shortly apiculate.

Distr. *Malesia*: S.E. Celebes (Kendari), S.E. Moluccas (Aru Is. ?) and Japen I. (sterile collections)?

Vern. *Pooti* (Celebes), *koereh*, *mandonor* (Biak), *kamoera* (Aru).

## 2b. Subsection *Pierrea*

(HEIM) ASHTON, Gard. Bull. Sing. 20 (1963) 259; Man. Dipt. Brun. (1964) 91; GUTIERREZ, Act. Manil. 4, A. 2 (1968) 25, 26. — *Pierrea* HEIM, non HANCE. — *Pierreocarpus* RIDL. ex SYM. in syn. — *Hopea*, *Pierrea* group SYM. Gard. Bull. S. S. 9 (1934) 32; Mal. For. Rec. 16 (1943) 108. — **Fig. 74.**

Panicles glabrescent, fascicled; ovary and stylopodium hour-glass-shaped, elongate; style short, obscure; bark surface generally smooth, or shallowly papery flaked, usually stilt-rooted.

Distr. *Malesia*: Malaya, Borneo, Philippines.

Note. The least well defined of the four subsections. The New Guinea species, with their elongate stylopodia and in several cases large leaves with unequal bases are almost intermediate between subsections *Hopea* and *Pierrea*, as also to a large extent are some Indochinese species in the type subsection (e.g. *H. oblongitolia* DYER, *H. reticulata* TARDIEU, *H. hongayanensis* TARDIEU), while *H. glaucescens* and *H. wyatt-smithii* share the flower colour and leaf-shape of the *H. nervosa* group within *subsect. Sphaerocarpaceae*.

**71. *Hopea glaucescens*** SYM. J. Mal. Br. R. As. Soc. 19 (1941) 142, pl. 2; Mal. For. Rec. 16 (1943) 126, f. 69. — *Hopea* sp. nov. SYM. J. Mal. Br. R. As. Soc. 14 (1936) 348.

Medium-sized, smooth-barked tree, often stilt-rooted. Panicles sparsely persistently puberulent, twigs and petioles fugaceously so, petals outside persistently densely gold pubescent. *Twig* 2–3 mm  $\varnothing$  apically, becoming dark brown, terete; with prominent ribs along the leaf traces; stipule scars minute. *Bud* to 2 by 2 mm, ovoid; *stipules* fugaceous. *Leaves* 9–18 by 3.5–9 cm,  $\pm$  elliptic, coriaceous, glaucescent beneath in mature trees; base cuneate; acumen to 1 cm long, slender, prominent; nerves 12–15 pairs, slender but relatively prominent beneath, obscure above, with many distinct short secondary nerves; tertiary nerves slender, subscalariform, evident to obscure in mature trees; midrib distinctly elevated on both surfaces; *petioles* 10–15 mm long. *Panicle* to 4 cm long, terminal or axillary to ramiflorous, with to 2 cm long branchlets bearing to 8 congested secund flowers. *Flower bud* to 4 by 3 mm, ovoid. *Sepals* subequal, broadly ovate, the outer 2 subacuminate, the inner 3 mucronate. *Stamens* 15; filaments broadly compressed at base, tapering and filiform distally; appendages aristate, c.  $3 \times$  length of the small subglobose anthers; *style* and *stylopodium* hour-glass-shaped, equal in height but the ovary the broader; style short, tapering. *Fruit pedicel* to 1 mm long, slender. 2 longer calyx lobes to 7 by 1.5 cm, spatulate, obtuse, c. 5 mm broad above the

to 8 by 5 mm ovate saccate thickened base; 3 shorter lobes to 20 by 5 mm, linear-lorate, similar at base, completely enclosing nut. *Nut* to 9 by 7 mm, ovoid, apiculate.

Distr. *Malesia*: Malaya.

Ecol. Rare, below 500 m, in Mixed Dipterocarp forest.

Vern. *Mĕrawan kĕlabu*, *m. galor*, *m. jangkang*, *m. tĕngkok biawak*.

**72. *Hopea wyatt-smithii*** WOOD ex ASHTON, Gard. Bull. Sing. 19 (1962) 260, pl. 4; Man. Dipt. Brun. (1964) 113, f. 12; *ibid.* Suppl. (1968) 58; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 227, f. 33. — **Fig. 74B–B4.**

Small to medium-sized smooth-barked prominently stilt-rooted tree. All parts glabrous but for petals and ovary. *Twig* c. 1 mm  $\varnothing$  apically, smooth. *Bud* to 1.5 mm long, ovoid. *Stipule* to 2 mm long, linear, fugaceous. *Leaves* 9–14 by 5.5–9 cm, broadly ovate to elliptic, undersurface sparsely greyish lepidote; base broadly cuneate, occasionally obtuse; acumen caudate to 2 cm long; nerves 4–8 pairs, well spaced, irregularly disposed owing to frequent presence of short but prominent secondaries; slender, slightly raised beneath, basal 2–3 pairs straight, at first decurrent with midrib, distal pairs curved at  $40^\circ$ – $50^\circ$ ; tertiary nerves well spaced, scalariform, at  $90^\circ$  or ascending; midrib slender, appanate beneath acute above; *petiole* 1.2–1.7 cm long. *Panicle* to 6 cm long,

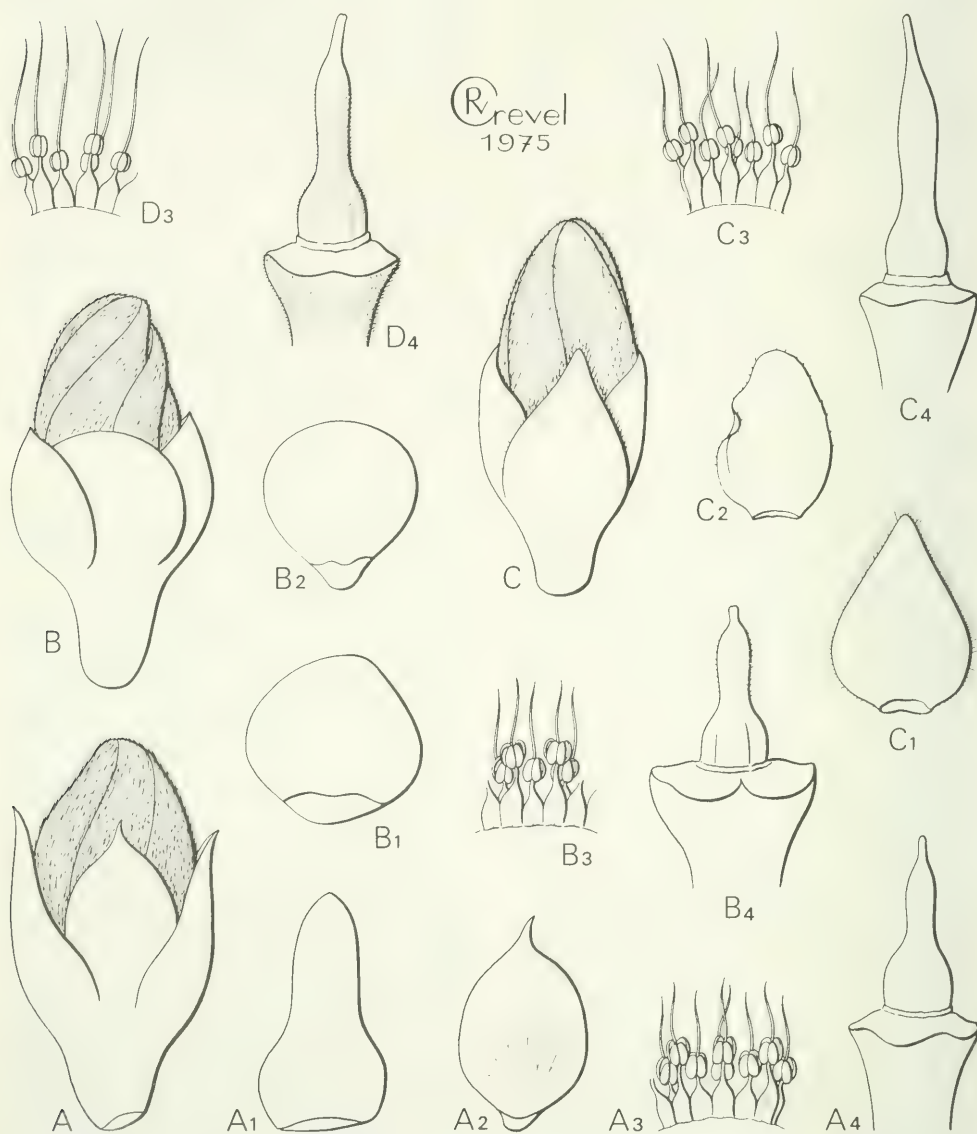


Fig. 74. Flower details in *Hopea* sect. *Hopea* subsect. *Pierrea* (HEIM) ASHTON. All  $\times 10$ . Sepals drawn from inside. — *Hopea philippinensis* DYER. A. Bud, A1. outer sepal, A2. inner sepal, A3. stamens from inside, A4. pistil. — *H. wyatt-smithii* WOOD ex ASHTON. B. Bud, B1. outer sepal, B2. inner sepal, B3. stamens from inside, B4. pistil. — *H. bilitonensis* ASHTON. C. Bud, C1. outer sepal, C2. inner sepal, C3. stamens from inside, C4. pistil. — *H. apiculata* SYM. D3. Stamens from inside, D4. pistil (A RAMOS & EDANO BS 31296, B WOOD 15061, C bb. 23087, D KEP 98175).



terminal or to 2-axillary, glabrous, terete or  $\pm$  compressed; singly branched, branchlets to 1.5 cm long, bearing to 6 secund flowers; *bracteoles* small, deltoid, glabrous. *Flower bud* to 3 mm long, subglobose. *Calyx* glabrescent, with a shortly fimbriate margin, spreading; lobes subequal, broadly ovate to suborbicular, obtuse. *Petals* dark red, oblong-lanceolate, obtuse, densely pubescent on parts exposed in bud. *Stamens* 15; filaments broad at base, tapering abruptly; anther broadly oblong, cells subequal; appendage to connective about twice length of anther, slender. *Ovary* and *stylopodium* narrowly hour-glass shaped; ovary glabrous, stylopodium somewhat longer than ovary, puberulent, crowned by a short glabrous style. *Fruit calyx* entirely glabrous; 5 lobes equal, to 10 by 8 mm, ovate, subacute, shallowly saccate, thickened, closely imbricate and adpressed to the nut. *Nut* to 1.2 cm long and  $\varnothing$ , ovoid, acute, enclosed by calyx but for an up to 3 mm  $\varnothing$  apical gap.

Distr. *Malesia*: Borneo (Sarawak N.E. of the Lupar, S.W. and S.E. Sabah).

Ecol. Local, on clay rich soils in Mixed Dipterocarp forest on low hills.

Vern. *Mérawan puteh* (Brun.), *sēlangan daun bulat* (Sabah).

**73. *Hopea polyalthioides* SYM.** J. Mal. Br. R. As. Soc. 19, 2 (1941) 146, pl. 4; Mal. For. Rec. 16 (1943) 140, f. 69.

Small monopodial smooth-barked tree. Twig and petiole densely persistently fulvous tawny pubescent, leaf undersurface and midrib above sparsely so; panicle glabrous. *Twig* c. 3 mm  $\varnothing$  apically, stout, terete, becoming dark brown, with a prominent short rib at first following the leaf trace; internodes 1–5 cm long; stipule scars obscure; *stipules* unknown. *Leaves* (8–)14–27 by (2.5–)4–6 cm, narrowly oblong-lanceolate, coriaceous; base subcordate; acumen short, broad; nerves 10–13 pairs, arched and becoming wavy at the margin, prominent beneath,  $\pm$  obscure above, sometimes with a few short indistinct secondary nerves; midrib stout and prominent beneath, slender, elevated to shallowly channelled, above; *petiole* 5–8 mm long, c. 3 mm  $\varnothing$ , short, stout. *Panicles* to 11 cm long, very slender, laxly shortly branched; flowers and fruit unknown.

Distr. *Malesia*: Malaya (S. Johore).

Ecol. Rare, in well-drained forest.

Vern. *Giam rambai*, *rēsak*, *r. rambai*, *sēlumar*.

**74. *Hopea gagayanensis* (FOXW.) SLOOT.** Reinwardtia 3 (1956) 318. — *Balanocarpus gagayanensis* Foxw. Philip. Journ. Sc. 13 (1918) Bot. 194, pl. 2; *ibid.* 67 (1938) 285, pl. 3; MERR. En. Philip. 3 (1923) 101; REYES, Philip. J. Sc. 22 (1923) 335; SYM. Gard. Bull. S. S. 8 (1934) 17, 32.

Large, flaky-barked tree. Twigs, leaf bud, stipules, petioles, domatia and parts of petals exposed in bud densely persistently tawny pubescent; nerves and midrib above caducously so; panicle and nerves and midrib beneath sparsely caducously so. *Twigs* c. 1 mm

$\varnothing$  apically, slender, much branched, becoming smooth, terete. *Buds* c. 2 by 1 mm, small, ovoid; *stipules* to 4 mm long, linear, not at first caducous. *Leaves* 8–10 by 2.5–4 cm, lanceolate, thinly coriaceous; base unequal, broadly cuneate or obtuse on the adaxial side, subcordate on the abaxial; acumen to 1.5 cm long, slender, subcaudate; nerves 9–12 (to 14 in young trees) pairs, slender but prominent beneath, applanate above, arched, at 55°–65°, with domatia; secondary nerves short, obscure; tertiary nerves densely scalariform, evident and  $\pm$  elevated beneath; midrib slender but evident and distinctly elevated on both surfaces; *petiole* 5–7 mm long, short. *Panicle* to 5 cm long, to 2-axillary, slender; singly branched, branchlets bearing to 3 flowers; *bracts* and *bracteoles* to 1 mm long, minute, deltoid, not at first caducous. *Flower bud* to 2.5 by 1.5 mm, ellipsoid. *Sepals* subequal, broadly ovate, shortly acuminate. *Stamens* 15, shorter than style, in 3  $\pm$  unequal verticils; filaments broad and compressed at base, tapering and filiform in the distal  $\frac{1}{2}$ ; anthers broadly oblong; appendages c. twice length of anther, slender. *Ovary* small, ovoid, tapering into an equally long somewhat narrower cylindrical punctate stylopodium and shorter columnar style. *Fruit* subsessile; *sepals* short, subequal; adpressed to the nut; outer 2 to 9 by 7 mm, ovate-acuminate, incrassate; inner 3 to 10 by 10 mm, broadly ovate, obtuse, thin. *Nut* to 15 by 10 mm, ovoid, apiculate,  $\pm$  thinly resin-coated.

Distr. *Malesia*: Philippines (N.E. Luzon: Cagayan Prov.).

Ecol. Locally frequent, semi-evergreen forests.

Uses. House posts.

Vern. *Narek*.

**75. *Hopea paucinervis* PARIJS** in Fedde, Rep. 33 (1933) 243.

Medium-sized tree. Young parts fugaceous buff puberulent. *Twigs* slender. *Stipules* fugaceous, unknown. *Leaf* 4.5–8 by 2.5–4.5 cm, ovate-lanceolate, coriaceous; base subequal, obtuse or broadly cuneate; apex shortly acuminate; nerves 7–10 pairs, ascending, curved, prominent beneath; tertiary nerves subscalariform, elevated beneath. *Petiole* 8–12 mm long. *Panicle* to 4 cm long, to 2-axillary, axillary to ramiflorous. Buds and opened flowers and fruit are unknown. *Sepals* of old flowers unequal, ovate-lanceolate. *Stamens* 15, in 3  $\pm$  unequal verticils; filaments loriate, tapering in distal  $\frac{1}{4}$ ; anthers oblong; appendages equal to anther, short. *Ovary* and *stylopodium* equal, overall pyriform with prominent intermediate constriction.

Distr. *Malesia*: S.E. Sumatra (Djambi).

**76. *Hopea apiculata* SYM.** Gard. Bull. S. S. 8 (1935) 277, pl. 21; Mal. For. Rec. 16 (1943) 120, f. 69, 70. — **Fig. 74 D3–D4.**

Small smooth-barked tree with sharp, often stilted buttresses. Twigs caducous tawny puberulent, petioles and outside of petals densely persistently pubescent, otherwise glabrous. *Twigs* c. 2 mm  $\varnothing$  apically, straight, infrequently branched, pendant,



Fig. 75. *Hopea pachycarpa* (HEIM) SYM. *a.* Node with leaf and inflorescence, *b.* branch with young fruits, *c.* ripe fruit, *d.* ditto with sepals removed, all  $\times \frac{1}{2}$  (a S 22406, with flowers of ANDERSON S 15408, c-d bb. 35260).

terete, pale brown; stipule scars minute, horizontal; leaves distant. *Buds* minute; *stipule* small, linear, caducous. *Leaves* alternate, 12–26 by 4–8 cm, narrowly oblong-lanceolate, subcoriaceous; base cordate, equal; acumen short; nerves 12–15 pairs, the first 2–3 arising from the base, slender but prominent beneath, shallowly depressed above, arched; midrib prominent beneath, obscure and depressed or sometimes evident and elevated above; tertiary nerves densely subreticulate, evident beneath, obscure above; *petiole* 6–12 mm long, c. 3 mm  $\varnothing$ , stout. *Panicles* to 20 cm long, terminal or ramiflorous, borne densely along the twigs, slender, laxly branched; branchlets to 2 cm long, unbranched, bearing to 6 secund flowers. *Flower bud* to 5 by 3 mm, ovoid; sepals ovate-lanceolate, fimbriate, acuminate, the outer 2 somewhat larger, sometimes obtuse; *petals* pale yellow. *Stamens* 15, filaments dilated at base, tapering; appendages very slender, 4–5 times as long as subglobose anthers. *Ovary* and *stylopodium* hour-glass-shaped, the latter somewhat the larger, with intervening frequently puberulent constriction; style columnar, shorter than ovary. Fruit pedicel to 1 mm long, short. *Sepals* to 2.5 by 0.5 cm but usually shorter than

nut (variable, even on one tree), unequal to subequal, spatulate to ovate-acuminate, thickened and saccate at base; *nut* to 20 by 12 mm, ovoid, prominently apiculate.

Distr. *Malesia*: Malaya (Perak). SMITINAND (Thai For. Bull., Bot. 12, 1980, 45) records this also from Peninsular Thailand and S. Burma (Kemas); I have not seen this material.

Ecol. Very local, common in two valleys east of the Keledong Saiong range.

Vern. *Mēlukut*, *rēsak mēlukut*.

77. *Hopea pachycarpa* (HEIM) SYM. Gard. Bull. S. S. 8 (1934) 30, pl. 8; BROWNE, For. Trees Sarawak & Brunei (1955) 125; ASHTON, Man. Dipt. Brun. (1964) 105, f. 12; *ibid.* Suppl. (1968) 54; Gard. Bull. Sing. 22 (1967) 271; *ibid.* 31 (1978) 35. — *Pierrea pachycarpa* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 958; Rech. Dipt. (1892) 78, pl. 7; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 268; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 113; MERR. En. Born. (1921) 408; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 263. — *Balanocarpus pubescens* RIDL. Fl. Mal. Pen. 1 (1922) 247; FOXW. Mal. For. Rec. 10 (1932) 147; SYM. Gard. Bull. S. S. 8



(1934) 28, 32; BURK. Dict. (1935) 288. — *Pierreocarpus pachycarpa* RIDL. ex SYM. Gard. Bull. S. S. 8 (1934) 30, *nomen in syn.* — *H. laxa* SYM. Gard. Bull. S. S. 8 (1934) 33, pl. 9; BROWNE, For. Trees Sarawak & Brunei (1955) 125; cf. ASHTON, Gard. Bull. Sing. 22 (1967) 271; ASHTON, Man. Dipt. Brun. Suppl. (1968) 54. — *H. resinosa* SYM. Gard. Bull. S. S. 8 (1935) 278, pl. 23; Mal. For. Rec. 16 (1943) 141, f. 68B, 69. — **Fig. 75, 76.**

Young twig, leaf bud, stipule outside (glabrous within) and petiole shortly persistently pale fawn tomentose; leaf glabrous. *Twig* to 2 mm  $\varnothing$  apically, terete, becoming smooth. *Bud* to 2.5 by 2 mm, ovoid to globose. *Stipule* to 4 mm long, linear, fugaceous. *Leaves* 13–22 by 4–7 cm, thinly coriaceous, elliptic to lanceolate, with or without silvery lepidote undersurface; base subequal, cuneate on one side, obtuse on the other; acumen to 1 cm long, narrow; nerves (10–)13–17 pairs, slender but distinctly raised beneath, at 45°–55° but curving round to run parallel to the margin before terminating at it, with small tomentose domatia; tertiary nerves slender, densely scalariform, sinuate, diagonal to nerves; midrib rounded, raised on both surfaces; *petiole* 7–10 mm long, short, stout. *Panicle* to 8 cm long, axillary to ramiflorous, terete, puberulent or glabrescent, to 2-axillary, rarely branched; *bracteoles* to 2 mm long, linear, not at first caducous. *Flower bud* to 4 by 2.5 mm, broadly ellipsoid. *Calyx* glabrous but for the fimbriate margin; 2 outer lobes broadly ovate, subacute; 3 inner lobes broader, slightly shorter, subacuminate. *Petals* broadly oblong, glabrescent, strongly contorted in bud. *Stamens* 15, in 3 unequal verticils, the 5 inner anther's length longer than the 10 outer; filaments broad at base, tapering, filiform distally; anthers subglobose; appendage to connective slender, 2–3 times length of anther, glabrous. *Ovary* small, ovoid, glabrous; style and stylopodium spindle-shaped, glandular-papillose towards apex, tapering into short glabrous style. *Fruit* entirely glabrous. 5 *calyx lobes* subequal, to 2 by 1.5 cm, ovate, subacute, thickened, deeply saccate, closely adpressed to nut; apex of nut visible only at 5 mm  $\varnothing$  apical gap. *Nut* to 1.5 cm  $\varnothing$ , subglobose; style remnant short, abrupt, acute.

Distr. *Malesia*: Malaya (Pahang, E. Johore), Central Sumatra, Ankola in W. Sumatra, Borneo (Ulu Kapuas, Sarawak, Brunei, Berau).

Ecol. Locally abundant on moist soils on lower hillsides and alluvium in Mixed Dipterocarp forest.

Vern. *Bayan*, *mērawan mata kuching* (Mal.), *mēlapi bērjangkang* (Kapuas), *mērkoyong* (Sar.).

**78. *Hopea bilitonensis* ASHTON**, Gard. Bull. Sing. 31 (1978) 35. — **Fig. 74 C–C4.**

Small smooth-barked tree with stilt roots. Leaf buds and parts of petals exposed in bud densely tawny pubescent, young twigs and panicles fugaceously so, otherwise glabrous. *Twigs* c. 1 mm  $\varnothing$  apically, slender, much branched, red-brown, terete, smooth. *Leaf buds* c. 1 by 1 mm, ovoid, acute; *stipules* unknown,

fugaceous. *Leaves* 7.5–16 by 3.5–6 cm, ovate-lanceolate,  $\pm$  chartaceous, lustrous; base obtuse to subcordate, subequal; acumen to 2 cm long, attenuate; nerves 6–8 pairs, slender but prominent beneath, applanate above, arched, at 50°–60°; secondaries absent; tertiary nerves remotely subscleriform, evident and distinctly elevated beneath; *petiole* 6–8 mm long, short. *Panicle* to 18 cm long, slender, axillary, solitary, lax, pendant; twice branched, branchlets to 4 cm long, bearing to 6 flowers; *bracts* and *bracteoles* minute, deltoid, caducous. *Flower bud* to 3 by 2 mm, lanceolate. *Sepals* fimbriate; 2 outer deltoid, subacute; 3 inner ovate, subacute. *Stamens* 15, in 3 unequal verticils, shorter than style at anthesis; filaments somewhat slender, compressed at base, tapering distally and filiform beneath the small subglobose anthers; appendages c.  $3\frac{1}{2}$  times as long as anthers, very long and slender,  $\pm$  crisped. *Ovary* small, ovoid, with somewhat longer oblanceolate stylopodium and short terminal style. *Fruit pedicel* to 2 mm long, stout. 2 longer *calyx lobes* to 5 by 1.2 cm, broadly spatulate, obtuse, c. 7 mm broad above the to 7 by 4 mm subauriculate centrally thickened base; 3 shorter lobes to 9 by 6 mm, ovate, acuminate, shorter than nut. *Nut* to 10 by 6 mm, ovoid, prominently slender apiculate.

Distr. *Malesia*: E. Sumatra (Banka and Billiton); Malaya (Perak, once).

Ecol. Locally common in lowland forest, once recorded from limestone in N.W. Malaya.

Vern. *Pēlepak*.

Notes. An interesting species, locally common on the sandy islands of Banka and Billiton and now recorded from limestone in a distinctly disjunct position in relatively seasonal N.W. Malaya, a range that has apparently become disjunct since the Pleistocene.

Though an isolated species on account of its leaves, solitary axillary inflorescences and small fruit, the leaves nonetheless recall those of the anomalous *H. polyalthioides* SYM. of East Johore, still unknown in flower or fruit, though they differ in size and shape.

**79. *Hopea bullatifolia* ASHTON**, Gard. Bull. Sing. 22 (1967) 274, pl. 18; Man. Dipt. Brun. Suppl. (1968) 48, f. 6.

Small smooth-barked stilt-rooted tree. Leaf bud, stipule outside (glabrous within), petiole and midrib beneath densely persistently evenly tawny pubescent, nervation and lamina beneath and midrib above sparsely so. *Twig* c. 2 mm  $\varnothing$ , terete, becoming smooth. *Bud* to 1 by 1 mm, small, subglobose. *Stipule* to 4 mm long, linear, caducous. *Leaves* 16–34 by 4.5–9 cm, oblong, prominently bullate between the tertiary nerves; base cordate, subequal; acumen to 1 cm long, slender; nerves 17–26 pairs, slender but prominent beneath, depressed above, at 35°–45°, frequently linked to form a looped intramarginal nerve distally; tertiary nerves scalariform, prominent beneath, depressed above; midrib prominent on both surfaces; *petiole* 3–6 mm long, short, stout. *Flowers* unknown.



Fig. 76. *Heopea pachycarpa* (HEIM) SYM. Leaf from sterile branch,  $\times \frac{1}{2}$  (S 22035).

*Inflorescences* unknown. *Fruit* entirely glabrous; 2 longer *calyx lobes* to 8 by 1.5 cm, spatulate, obtuse, *c.* 4 mm broad above the to 8 by 3 mm ovate thickened saccate base; 3 shorter lobes to 15 mm long, lanceolate, acute, slender, similar at base, enclosing the nut. *Nut c.* 10 by 7 mm, ovoid, apiculate, enclosed in the sepals.

Distr. *Malesia*: Borneo (Central Sarawak; S.E. Kalimantan, Pulau Laut).

Ecol. Rare, in Mixed Dipterocarp forest on shale knolls.

**80. *Heopea pterygota*** ASHTON, Gard. Bull. Sing. 22 (1967) 280, pl. 26; Man. Dipt. Brun. Suppl. (1968) 55, f. 8.

Small tree. Vegetative parts at first densely pale tawny pubescent, caducous first on lamina, nervation beneath, petiole and then twig, persistent on buds and

stipules. *Twig c.* 2 mm  $\varnothing$  apically, becoming smooth, glabrous. *Bud* to 2 by 1 mm, ovoid, acute. *Stipule* to 4 mm long, linear, caducous. *Leaves* 12–28 by 5–9 cm, oblong-lanceolate to oblanceolate; base obtuse to subcordate, unequal, the larger side adjacent to the twig; acumen to 2 cm long, subcaudate; margin somewhat revolute; nerves 12–21 pairs, slender, scalariform, diagonal to midrib and nerves; midrib prominent on both surfaces, more so beneath than above; *petiole* 3–8 mm long, short, stout. *Panicle* to 8 cm long, terete, glabrous, slender, frequently fasciculate, frequently borne up the branches behind the leafy twigs; singly branched, branchlets bearing to 8 second flowers. *Flower bud* to 3 by 2 mm, ellipsoid. *Calyx* glabrous, 2 outer sepals lanceolate, acuminate, 3 inner suborbicular, somewhat shorter, shortly mucronate. *Petals* linear, pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the subglobose anthers; appendage to connective slender, 3–4 times as long as anthers. *Ovary* narrowly ovoid, glabrous, surmounted by a spindle-shaped glabrous stylopodium and style somewhat shorter than the ovary in length. *Fruit* glabrous. *Pedice*l to 1 mm long, short. 2 longer *calyx lobes* to 10 by 1.5 cm, spatulate, chartaceous, *c.* 4 mm broad above the to 2 cm long, to 7 mm wide paired basal auricles, with a to 5 by 4 mm central basal ovate saccate thickened area; 3 shorter lobes to 3 cm long, with up to 12 by 4 mm tapering subacute lobe above a similar base. *Nut* to 7 by 5 mm, ovoid, acute, entirely concealed by auricles.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Ecol. Locally common in Heath forest and ridge tops; podsolis and skeletal soils, to 1000 m.

Note. This species is variable in leaf size; some collections of *H. bullatifolia* from Kalimantan approach it, and the two species may eventually prove conspecific.

**81. *Heopea philippinensis*** DYER, J. Bot. 16 (1878) 100; VIDAL, Phan. Cuming. (1885) 97; Rev. Pl. Vasc. Filip. (1886) 62; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 64; EVERETT & WHITFORD, Bull. Bur. For. Philip. 5 (1906) 16, 28, 53; WHITFORD, Bull. Bur. For. Philip. 10, 2 (1911) 75; Foxw. Philip J. Sc. 4 (1909) Bot. 515; *ibid.* 6 (1911) Bot. 261; *ibid.* 13 (1918) Bot. 183; *ibid.* 67 (1938) 276; MERR. En. Philip. 3 (1923) 94; REYES, Philip. J. Sc. 22 (1923) 338; SYM. Gard. Bull. S. S. 8 (1934) 32; *ibid.* 8 (1935) 279; GUTIERREZ, Act. Manil. 4, A, 2 (1968) 65, f. 13, pl. 9. — *H. odorata* (non ROXB.) VIDAL, Sinopsis (1883) t. 15, f. A. — **Fig. 74 A–A4.**

Small, smooth-barked buttressed tree. Twigs, petioles, domatia, leaf bud, stipules and parts of petals exposed in bud densely persistently pale tawny pubescent; midrib above (densely puberulent in young trees) and panicle glabrescent. *Twig c.* 2 mm  $\varnothing$  apically, ribbed, becoming terete, red-brown. *Buds* small, ovoid; *stipules* to 5 mm long, linear, fugaceous. *Leaves* (7–)12–25 by (2.5–)4–7 cm, narrowly elliptic-oblong to lanceolate, thinly coriaceous; base unequal, cuneate abaxially, cordate adaxially; acumen to 2 cm



long, slender, subcaudate; nerves 17–22 pairs, slender but prominent beneath, obscurely depressed above, arched, at 50°–60°, with axillary tomentose domatia, without secondaries; tertiary nerves densely scalariform, very slender but evident and distinctly elevated beneath; midrib slender but prominent beneath, elevated above; *petiole* 5–7 mm long, short. *Panicle* to 5 cm long, 1-axillary to ramiflorous, slender, rather lax, singly branched; branchlets to 1.5 cm long, bearing to 4 flowers; *bracteoles* minute, deltoid, fugaceous. *Flower bud* to 3 by 2 mm, ellipsoid. 2 outer *sepals* lanceolate-acuminate; 3 inner broadly ovate, shortly acuminate. *Stamens* 15, slightly shorter than style at anthesis; filaments compressed at base, tapering and filiform in the distal  $\frac{2}{3}$ ; anthers subglobose; appendages *c.* 2½ times length of anthers, slender. *Ovary* and *stylopodium* hour-glass shaped, the ovary slightly the broader; style short but distinct. *Fruit pedicel* short, base of fruit impressed. 2 longer *calyx lobes* to 12 by 3 cm, spatulate, obtuse, *c.* 3 mm broad above the to 9 by 8 mm ovate deeply saccate thickened base; 3 shorter lobes to 7 by 8 mm, broadly ovate, mucronate, shorter than nut. *Nut* to 11 by 8 mm, broadly ovoid, shortly apiculate.

Distr. *Malesia*: Philippines.

Ecol. Widespread and common in evergreen non-seasonal forest on hills to 500 m.

Vern. *Bagitarim* (Tag.), *baguatsan*, *bagupsan* (Bik.), *bantaya* (S. L. Bis.), *gisok* (P. Bis., Mbo., Lan., C. Bis.), *gisok gisok* (P. Bis., Sul., Sh. Bis.), *gisok nga-salangan* (S. L. Bis.), *kuli lisian*, *maka taying* (Tag.), *malatamban* (Bik.), *malibato* (Mbo.), *mang-laum* (Tag.), *malalamba*, *malatagum*, *pagak son* (Bik.), *paina* (Tag.), *pongo*, *subigan* (S. L. Bis.).

**82. *Hopea mindanensis*** Foxw. Philip. J. Sc. 6 (1911) Bot. 261, pl. 43; *ibid.* 13 (1918) Bot. 183; *ibid.* 67 (1938) 277; MERR. En. Philip. 3 (1923) 93; REYES, Philip. J. Sc. 22 (1923) 334; SYM. Gard. Bull. S. S. 8 (1934) 32; GUTIERREZ, Act. Manil. 4, A, 2 (1968) 63, f. 12, pl. 8.

Medium-sized hard-wooded tree, with blackish flaky bark. Twigs, petioles, leaf buds and domatia ± persistently pale tawny pubescent, parts elsewhere glabrescent. *Twig* *c.* 5 mm Ø apically, stout, becoming terete, pale brown. *Leaves* 30–60 by 9.5–18 cm, large, narrowly oblong, thinly coriaceous; base unequal, cordate; acumen to 3 cm long, prominent; nerves 22–28 pairs, prominent beneath, ± shallowly depressed above ascending at 50°–60°, straight but arched at the margin and running along parallel to it before terminating; with small pubescent pore-like axillary domatia; tertiary nerves ± densely scalariform, very slender but distinctly elevated beneath; *petiole* 15–18 mm long, *c.* 5 mm Ø, short, relatively stout, *panicle* to 6 cm long, short, to 2-axillary or ramiflorous, singly branched. *Flower buds* to 3 by 2 mm, ovoid-lanceolate. 2 outer *sepals* ovate, acuminate; 2 inner suborbicular, acute. *Stamens* 15, subequal; filaments compressed, rather broad, tapering; appendages very slender, *c.* 1½ as the ellipsoid anthers. *Ovary* ovoid, surmounted by a prominent

spindle shaped stylopodium of equal length, with a prominent intervening constriction; style shorter than stylopodium but prominent, tapering. *Fruit pedicel* short; 2 longer *calyx lobes* to 11 by 15 cm, narrowly spatulate, obtuse, *c.* 3 mm broad above the to 9 by 7 mm ovate saccate thickened base; 3 shorter lobes to 12 by 8 mm, ovate, thin, saccate, appressed to nut; *nut* to 12 by 8 mm, ovoid, prominently apiculate, resinous.

Distr. *Malesia*: Philippines (Mindanao).

Ecol. Frequent in lowland evergreen forest.

Vern. *Bagasusu* (Zamboanga), *magasusu* (Sulu), *ganon* (Sub.), *yakal magasusu* (official name).

**83. *Hopea tenuinervula*** ASHTON, Gard. Bull. Sing. 22 (1967) 281, pl. 27, 349 (phot. habit); Man. Dipt. Brun. Suppl. (1968) 57. — *H. philippinensis* (non DYER) ASHTON, Man. Dipt. Brun. (1964) 107, f. 12.

Small to medium-sized stilt-rooted tree with papery flaky bark. Young vegetative parts densely pale tawny tomentose, persistent on buds and stipules, ± persistent on nervation beneath and midrib above; elsewhere caducous. *Twig* to 2 mm Ø apically, becoming smooth, glabrous. *Bud* to 3 by 1.5 mm, lanceolate. *Stipule* to 5 mm long, linear, subpersistent. *Leaves* alternate, 10–27 by 3–5.5 cm, narrowly ovate to lanceolate; base obtuse, pronouncedly unequal, the larger side adjacent to the twig, acumen to 1 cm long, narrow; margin revolute; nerves 12–21 pairs, slender, prominent beneath, at 50°–60°; curving and running parallel to margin before terminating at it; tertiary nerves slender, densely scalariform, at 90°; midrib rounded, raised on both surfaces; *petiole* 3–7 mm long, short, stout. *Panicle* to 8 cm long, to 2-axillary, rarely terminal, terete, lax, glabrous; singly branched, branchlets to 3 cm long, bearing to 4 second pale yellow flowers; *bracteoles* to 1 mm long, deltoid, glabrous, subpersistent. *Bud* to 4 mm long, ellipsoid, subsessile. *Calyx* glabrous but for fimbriate margin; 2 outer lobes narrowly ovate, prominently acuminate; 3 inner lobes suborbicular to broadly ovate, mucronate. *Petals* oblong, lanceolate, acute, densely pubescent on parts exposed in bud, otherwise glabrous. *Stamens* 15; filaments broad at base, tapering; anthers oblong-ellipsoid; appendage to connective slender, about twice length of anther. *Ovary* ovoid, glabrous; stylopodium as long as ovary, spindle-shaped, glabrous, indistinct from style. *Fruit* entirely glabrous; 2 longer *calyx lobes* to 10 by 1.7 cm, spatulate, narrowly obtuse, to 2 mm broad above the to 6 by 4 mm narrowly ovate prominently saccate thickened base; 3 shorter lobes to 3 cm long, subequal, acute, slightly auriculate at the to 7 mm broad base but otherwise similar. *Nut* to 12 by 8 mm, ovoid, almost completely enveloped by shorter calyx lobes; style remnant short, acute.

Distr. *Malesia*: Borneo (Sarawak, Brunei, S.E. Borneo).

Ecol. Locally abundant on leached sandy soils in Mixed Dipterocarp forest on low hills near Pleistocene coastlines.

Vern. *Mërawan daun serong*.

84. *Hopea enicosanthoides* ASHTON, Gard. Bull. Sing. 22 (1967) 276, pl. 21; Man. Dipt. Brun. Suppl. (1968) 50, f. 6.

Small smooth-barked stilt-rooted tree. Young twigs, buds, stipules, petioles and base of midrib above caducous pale tawny pubescent or glabrous. Twig *c.* 3 mm  $\varnothing$ , terete to somewhat compressed, smooth, prominently ribbed below the petiole insertion; stipule scars 5–8 short, obscure. Bud to 2 by 1 mm, conical, acute. Stipule to 8 mm long, linear, subpersistent. Leaf (16–)27–46 by (5–)8–15 cm, very large, oblong, coriaceous, prominently convex between the depressed nerves on the upper face; base cordate, unequal; acumen to 2.5 cm, long, slender; nerves 16–30 pairs, slender but prominent beneath; tertiary nerves densely scalariform, slender but evident beneath; petioles 5–8 mm long, short, stout. Flowers unknown. Panicle and fruit entirely glabrous. Panicle to 12 cm long, axillary to ramiflorous, frequently to 2-axillary, terete, lax, singly branched; branchlets to 3 cm long, ascending, bearing to 5 flowers; bracteoles *c.* 2 mm long, linear, subpersistent. Pedicel *c.* 1 mm long, short. 2 longer calyx lobes to 13 by 3 cm,  $\pm$  broadly spatulate, obtuse, *c.* 6 mm broad above the *c.* 12 by 10 mm ovate thickened saccate base; 3 shorter lobes to 20 mm long, lanceolate, acute, similarly saccate but hardly thickened at base, enfolding the nut. Nut to 10 by 6 mm, ovoid; style remnant to 2 mm long, filiform.

Distr. *Malesia*: Borneo (Sarawak, from the Rejang R. to Miri).

Ecol. On low, damp hillsides and, most frequently, banks of sluggish or tidal, but not brackish rivers, but

apparently intolerant of prolonged root immersion. Locally frequent.

#### Dubious

*Hopea parvifolia* (WARB.) SLOOT. Reinwardtia 2 (1952) 37. — *Anisoptera parvifolia* WARB. Bot. Jahrb. 13 (1891) 382; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 45; DIELS, Bot. Jahrb. 57 (1922) 461; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1926) 5 (misspelt *A. parviflora*); Nova Guinea 14 (1926) 225.

Nothing is known of this species apart from the inadequate original description; the type (WARBURG 20034) has not been found by myself and was not seen by BRANDIS or VAN SLOOTEN either. It was apparently in fruit, though it is not even possible from the description to be certain of the genus.

#### Excluded

*Hopea gracilis* MIQ. Sum. (1860) 490; DC. Prod. 16, 2 (1868) 635. BURCK (Ann. Jard. Bot. Btzig 6, 1887, 237) correctly excluded this species, based on a sterile TEYSMANN collection from Padang, Sumatra at Utrecht, from the family. Its correct identity remains obscure.

*Hopea siranda* MIQ. Sum. (1860) 489 = *Annonaceae*.

*Hopea sumatrana* KING ex GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 249, *nomen*. Quoted as producing resin of high quality. There is no other record of this name, which was certainly never published by KING.

### 10. SHOREA

ROXB. ex GAERTN. f. Fruct. 3 (1805) 48; ROXB. Pl. Corom. 3 (1815) t. 212; B. & H. Gen. Pl. 1 (1862) 193; DC. Prod. 16, 2 (1868) 628; DYER, Fl. Br. Ind. 1 (1874) 303; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 204; HEIM, Rech. Dipt. (1892) 36, *incl. sect.* *Anthoshorea* HEIM, l.c. 41, *sect.* *Hopeoides* HEIM, l.c. 43, *sect.* *Pachycarpae* HEIM, l.c. 44, *sect.* *Richetioides* HEIM, l.c. 48; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 73, *incl. sect.* *Pinanga* BRANDIS, l.c. 90, *sect.* *Mutica* BRANDIS, l.c. 100; FOXW. Philip. J. Sc. 67 (1938) 290, *incl. sect.* *Isoptera* (SCHEFF. ex BURCK) FOXW. l.c. 291, 301; SYM. Mal. For. Rec. 16 (1943) 1; MEIJER, Act. Bot. Neerl. 12 (1963) 322, *incl. subg.* *Richetia* (HEIM) MEIJER, *nom. inval.*, *subg.* *Rubroshorea* MEIJER, l.c. 322; ASHTON, Gard. Bull. Sing. 20 (1963) 261, *incl. sect.* *Neohopea* ASHTON, l.c. 266, *sect.* *Rubella* ASHTON, l.c. 267, *sect.* *Ovalis* ASHTON, l.c. 268; Man. Dipt. Brun. (1964) 115; *ibid.* Suppl. (1968) 60; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 48; ASHTON, Blumea 20 (1972) 360; Gard. Bull. Sing. 31 (1978) 36, *incl. sect.* *Pentacme* (A. DC.) ASHTON, l.c. 38; SMITINAND, Thai For. Bull. (Bot.) 12 (1980) 57. — SAUL ROXB. ex W. & A. Prod. (1834) 84, *nomen*. — *Doona* THW. in Hook. Kew J. 3 (1851) t. 12; *ibid.* 4 (1852) 7; DYER, Fl. Br. Ind. 1 (1874) 311; *cf.* ASHTON, Blumea 20 (1972) 361. — *Pentacme* A. DC. Prod. 16, 2 (1868) 626; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 72; SYM. Mal. For. Rec. 16 (1943) 104, f. 63 (map). — *Isoptera* SCHEFF. ex BURCK, Med. Lands Pl. Tuin 3 (1886) 27; BRANDIS,



J. Linn. Soc. Bot. 31 (1895) 105. — *Ridleyinda* O. K. Rev. Gen. Pl. 1 (1891) 65. — *Richetia* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 975. — *Anthoshorea* PIERRE *ex* HEIM, Rech. Dipt. (1892) 41, *nomen in syn.* — *Parahoopia* HEIM, *l.c.* 66. — *Pachychlamys* (DYER *ex* KING) DYER *ex* RIDL. Fl. Mal. Pen. 1 (1922) 233. — **Fig. 77–118.**

Medium-sized or large buttressed trees without stilt-roots; mature crown large, hemispherical or dome-shaped, sympodial. *Inflorescence* paniculate. *Calyx lobes* free to receptacle; 3 outer lobes thicker, somewhat longer, narrower, than 2 inner lobes in flower. *Petals* usually connate at base on falling, sometimes free. *Stamens* 10–∞; filaments variable, lorate to filiform; anthers subglobose to narrowly oblong; appendage to connective vestigial or prominent. *Ovary* tomentose, rarely glabrous; style with or without a distinct stylopodium. 3 outer fruit *calyx lobes* usually much longer than 2 inner lobes, thin, spatulate; or all lobes subequal; base of lobes  $\pm$  thickened, expanded, saccate. *Nut* free from calyx, pericarp splitting irregularly at germination. Unicellular scales, if present, broad-lobed.

Distr. About 194 *spp.* in Ceylon, India, Burma, Thailand, Indochina, and 163 *spp.* in *Malesia*: Malaya, Sumatra, Borneo and intervening islands, Java, Philippines and Moluccas. Fig. 79.

Fossil wood has been identified as *Shoreoxylon* from Timor in the Lesser Sunda Islands by SCHWEITZER (Palaeontographica 105B, 1959, 1–66) in which islands *Shorea* does not occur at present.

Ecol. The dominant emergent tree genus of the lowland forests of West Malesia; others occur and often are gregarious on river banks, on podsols and peat swamps; a few are montane, to 1750 m; some do not emerge from the main canopy.

Uses. The most important timber genus in the Asian humid tropics. *Sections Shorea*, *Pentacme* (Asian species only) and *Neohopea* yield a hard heavy timber suitable for construction and decking (*balau*, Malaya, *səlangan batu*, Borneo, *yakal*, Philippines); *sect. Richetioides* a yellowish brown light hardwood (*yellow mēranti*, Malaya, *yellow sēraya*, Sabah, *lun*, Sarawak); *sect. Anthoshorea* a white siliceous timber veneers (*white mēranti*, Malaya, *raruk*, Sarawak, *mēlapi*, Sabah), and the remaining sections pink, red or occasionally white or brown light medium or sometimes heavy hardwoods favoured for furniture as well as light construction (*red mēranti*, Malaya, *lup*, *pērawan*, Sarawak, *red sēraya*, Sabah, *red lauan*, Philippines).

Note. The subdivision of the genus accepted here has been more fully discussed by me in my paper of 1963.

#### SUBDIVISION OF SHOREA IN MALESIA

1. Appendage to connective barbate, stout, anthers 4-locular, with apices of anterior loculi barbate. Fig. 78, 82
  1. *Sect. Shorea*
2. Flower buds elongate, petals narrow falling separately; appendage to connective sparsely ciliate. Fig. 78. *Spp.* 1–28.
  - 1a. *Subsect. Shorea*
2. Flower buds globose before anthesis; petals short, oblong, connate at base on falling; appendages to connective and apices of anther cells densely barbate. Fig. 82. *Spp.* 29–35.
  - 1b. *Subsect. Barbata*
1. Appendages, if barbate surmounting a 2-locular anther, otherwise scabrous or glabrous; anthers glabrous.
  3. Anthers linear, prolonged apically into prominent horn-like processes. Fig. 84. *Spp.* 36–37
    2. *Sect. Pentacme*
  3. Anthers not as above.
    4. Appendage to connective not exceeding anther-apex, stout; stamens 15; anthers subglobose. Fruit calyx lobes subequal, elongated, much longer than the nut. Fig. 85. *Sp.* 38.
      3. *Sect. Neohopea*
    4. Appendage exceeding anther apex or, of short, either slender, recurved or with more than 30 stamens. Fruit calyx lobes subequal but shorter than nut, or unequal, 3 prolonged and spatulate.
      5. Anthers with 2 pollen sacs. Fig. 87, 89.
        4. *Sect. Richetioides*
      6. Stamens more than 100; anthers lorate. Fig. 87. *Sp.* 39.
        - 4a. *Subsect. Polyandrea*
      6. Stamens at most 17; anthers subglobose or oblong. Fig. 89. *Spp.* 40–71.
        - 4b. *Subsect. Richetioides*
      5. Anthers with 4 pollen sacs.
        7. Anthers linear to oblong; filaments lorate or tapering gradually (not abruptly medially); ovary without distinct stylopodium; style at least as long as ovary.
        8. Appendage to connective at least as long as anther, frequently scabrous. Wood yellow or white, with reticulate vessel arrangement in TS. Female silica present. Fig. 91B–C, 92. *Spp.* 72–92
          5. *Sect. Anthoshorea*



Fig. 77. *Shorea falciferoides* Foxw. a. Habit, b. leaf of seedling 1.2 m high, c. fruit, d. nut, all  $\times \frac{1}{2}$  (a SAN 37512, b S 5718, c-d S 2125).

8. Appendage to connective less than  $\frac{1}{3}$  the length of the anther; short, glabrous. Wood pink, with loose oblique vessel-arrangement in TS. Silica absent. Fig. 94, 95. *Spp.* 93–97 . . . . . 6. Sect. **Rubella**
7. Anthers broadly oblong to subglobose; appendage to connective vestigial, or shorter than the anther and reflexed, or, if long and unreflexed filaments tapering  $\pm$  medially or united in a tube round the ovary; stylopodium usually distinct. Wood pink, without silica; pore arrangement oblique, clustered or solitary, variable though never reticulate.
9. Stamens less than 30; filaments compressed and broad at base.
10. Appendage to connective filiform, slender, at least twice as long as the anther, not reflexed; filaments broad at base, tapering abruptly and filiform below the anthers.
11. Filaments broad at base, tapering abruptly medially, filiform, not fixed into a distinct tube round the ovary though frequently connate at base; ovary either with a distinct stylopodium and  $\pm$  pyriform, or without and small and ovoid; style filiform. Fig. 91D, 98–100
12. Stamens 24–28. Fig. 98. *Sp.* 98 . . . . . 7. Sect. **Brachypterae**
12. Stamens 15. Fig. 91D, 99–100. *Spp.* 99–122 . . . . . 7a. Subsect. **Smithiana**
12. Stamens 15. Fig. 91D, 99–100. *Spp.* 99–122 . . . . . 7b. Subsect. **Brachypterae**



- 11. Filaments united into a tube around the base of the ovary, tapering abruptly near apex; stylopodium merging into the style; style and stylopodium spindle-shaped, narrow and tapering at base and apex; or stylopodium indistinct, style at least twice as long as ovary, filiform. Fig. 103, 104. *Spp. 123–132* . . . . . 8. *Sect. Pachycarpae*
- 10. Appendage to connective shorter than or as long as the anther, becoming reflexed; filaments tapering gradually from base to anther. Fig. 106, 107 . . . . . 9. *Sect. Mutica*
- 13. Fruit calyx lobes auriculate at base. Fig. 107. *Spp. 133–138* . . . . . 9a. *Subsect. Auriculatae*
- 13. Fruit calyx lobes not auriculate. Fig. 106. *Spp. 139–159* . . . . . 9b. *Subsect. Mutica*
- 9. Stamens 50–70, appendage to connective vestigial; filaments filiform. Fig. 115. *Sp. 160* . . . . . 10. *Sect. Ovalis*

KEY TO THE SPECIES\*

- 1. Appendage to connective barbate, stout, anthers 4-locular with apices of anterior loculi barbate. Fig. 78. *S2*.  
*Spp. 1–35. 1. Sect. Shorea*
- 2. Flower buds elongate, petals narrow, falling separately; appendage to connective sparsely ciliate. Fig. 78.  
*Spp. 1–28. 1a. Subsect. Shorea*
- 3. Appendage to connective typically with 1–4 (a few appendages with up to 8) bristles, stamens otherwise glabrous.
- 4. Stamens more than 50; fruit calyx lobes vestigial though aliform and slightly exceeding ripe nut . . . . . 1. *S. collina*
- 4. Stamens at most 30; fruit calyx not as above.
- 5. Leaf undersurface persistently scabrid pubescent . . . . . 2. *S. ochrophloia*
- 5. Leaf undersurface glabrescent.
- 6. Nerves at least 15 pairs . . . . . 3. *S. guiso*
- 6. Nerves at most 14 pairs.
- 7. Fruit calyx lobes short, subequal . . . . . 4. *S. havilandii*
- 7. Fruit calyx lobes unequal, 3 aliform.
- 8. Stamens at least 40 . . . . . 5. *S. brunnescens*
- 8. Stamens less than 35.
- 9. Appendage mostly with a single apical bristle . . . . . 6. *S. scrobiculata*
- 9. Appendage with 2–4 bristles.
- 10. Petiole up to 14 mm long; stamens c. 30 . . . . . 7. *S. leptoderma*
- 10. Petiole at least 15 mm long; stamens less than 28.
- 11. Stamens c. 26; leaf lanceolate . . . . . 8. *S. ciliata*
- 11. Stamens 20; leaf ovate . . . . . 9. *S. submontana*
- 3. Appendage to connective with at least 5 bristles, or shoulder of filaments and usually anther apices setose.
- 12. Fruit calyx lobes subequal, shorter than nut.
- 13. Stamens c. 55, nut in fruit up to 5 by 5 cm . . . . . 10. *S. geniculata*
- 13. Stamens 25–40, nut in fruit c. 1 by 1 cm.
- 14. Stamens 30–40 . . . . . 11. *S. seminis*
- 14. Stamens 25 . . . . . 12. *S. sumatrana*
- 12. Fruit calyx lobes unequal, 3 longer lobes greatly exceeding nut.
- 15. Filaments distinctly barbate along the distal lateral margins.
- 16. Leaf of mature tree not cream or white lepidote beneath . . . . . 13. *S. foxworthyi*
- 16. Leaf of mature tree distinctly white or cream lepidote beneath.
- 17. Stamens at most 24 . . . . . 14. *S. lumutensis*
- 17. Stamens at least 25.
- 18. Young twigs compressed.
- 19. Tomentum on twig and petiole yellow-brown, scabrid; petiole less than 1.5 cm long . . . . . 15. *S. exelliptica*
- 19. Tomentum on twig and petiole buff, even; petiole 1.5–2.6 cm long . . . . . 16. *S. inappendiculata*
- 18. Twigs entirely terete.
- 20. Leaf falcate, base subequal, nerves beneath slender.
- 21. Stamens 33–44 . . . . . 17. *S. falcifera*
- 21. Stamens 25–32 . . . . . 18. *S. materialis*

\* Flowers are unknown from the *spp.* 161–163 which can, for that reason, also not be placed in a section, and are omitted from the key.

20. Leaf subequal, base equal, nerves beneath stout.
22. Stamens 25–33 . . . . . 19. *S. atrinervosa*
22. Stamens 35–46.
23. Petiole 3.5–5 cm long . . . . . 20. *S. crassa*
23. Petiole 1.2–2 cm long . . . . . 21. *S. obscura*
15. Filaments glabrous.
24. Stamens more than 40.
25. Leaf subequal, not lepidote beneath; nerves 11–15 pairs, stout beneath . . . 22. *S. lunduensis*
25. Leaf falcate, cream lepidote beneath; nerves less than 12 pairs, slender beneath . . . 23. *S. falciferoides*
24. Stamens 37 or less.
26. Nerves of leaf 16–24 pairs, pilose beneath . . . . . 24. *S. superba*
26. Nerves of leaf less than 16 pairs, epilose beneath.
27. Nerves 11–16 pairs; domatia if present very small.
28. Stamens c. 33; nerves applanate above . . . . . 25. *S. hypoleuca*
28. Stamens 35–37; nerves narrowly depressed above . . . . . 26. *S. malibato*
27. Nerves at most 12 pairs, with prominent pore-like axillary domatia.
29. Ovary with prominent stylopodium; stamens c. 32 . . . . . 27. *S. astylosa*
29. Ovary without stylopodium; stamens 25–30 . . . . . 28. *S. domatiosa*
1. Flower buds globose before anthesis; petals short, oblong, connate at base on falling; appendages to connective and apices of anther cells densely barbate. Fig. 82. *Spp.* 29–35. **1b. Subsect. Barbata**
30. Stamens at least 45.
31. Leaf 6–15 by 2.3–9 cm; nerves 7–10 pairs . . . . . 29. *S. glauca*
31. Leaf 6.5–10 by 2.5–4 cm; nerves 11–14 pairs . . . . . 30. *S. laevis*
30. Stamens at most 35.
32. Nerves 6–7 pairs, not sunken above; leaf less than 8 cm long.
33. Fruit calyx lobes subequal, shorter than nut . . . . . 31. *S. asahii*
33. Fruit calyx lobes unequal: 3 spatulate, thin, much longer than nut . . . . . 32. *S. micans*
32. Nerves more than 8 pairs, depressed above or, if not depressed, leaf exceeding 10 cm long.
34. Fruit calyx lobes subequal, shorter than nut.
35. Leaf coriaceous, nerves 5–6 pairs, not depressed above . . . . . 33. *S. ladiana*
35. Leaf thin, nerves more than 8 pairs, depressed above . . . . . 34. *S. biawak*
34. Fruit calyx lobes unequal, 3 spatulate, thin, much longer than nut . . . . . 35. *S. maxwelliana*
1. Appendages, if barbate, surmounting a 2-locular anther, otherwise scabrous or glabrous; anthers glabrous.
36. Anthers linear, prolonged apically into prominent horn-like processes. Fig. 84. *Spp.* 36–37.
- 2. Sect. Pentacme**
37. Deciduous hard-wooded trees; leaf base equal, nerves 13–16 pairs . . . . . 36. *S. siamensis*
37. Evergreen soft-wooded trees; leaf base unequal, nerves 7–9 pairs . . . . . 37. *S. contorta*
36. Anthers not as above.
38. Appendage to connective not exceeding anther apex, stout; stamens 15; anthers subglobose. Fruit calyx lobes subequal, elongated, much longer than the nut. Fig. 85. *Sp.* 38. **3. Sect. Neohopea**
38. *S. isoptera*
38. Appendage exceeding anther apex or, if short, either slender, recurved or with more than 30 stamens. Fruit calyx lobes subequal but shorter than nut or unequal, 3 prolonged and spatulate.
39. Anthers with 2 pollen sacs. Fig. 87, 89. *Spp.* 39–71. **4. Sect. Richetioides**
40. Stamens more than 100; anthers lorate. Fig. 87. *Sp.* 39. **4a. Subsect. Polyandreae**
39. *S. polyandra*
40. Stamens at most 17; anthers subglobose or oblong. Fig. 89. *Spp.* 40–71. **4b. Subsect. Richetioides**
41. Fruit calyx shorter than nut.
42. Fruit calyx lobes unequal, spatulate . . . . . 40. *S. kuantanensis*
42. Fruit calyx lobes subequal,  $\pm$  ovate.
43. Nut glabrous.
44. Petiole 1–1.2 cm long; floral ovary glabrous; stamens 15 . . . . . 41. *S. longiflora*
44. Petiole 1.8–3.8 cm long; floral ovary pubescent; stamens 10 . . . . . 42. *S. macrobalanos*
43. Nut pubescent.
45. Leaf of mature tree peltate . . . . . 43. *S. peltata*
45. Mature tree leaf not peltate.
46. Leaf less than twice as long as broad.
47. Stamens 16–17 . . . . . 44. *S. richetia*
47. Stamens 10–15.
48. Leaf nervation persistently cream pubescent beneath . . . . . 45. *S. laxa*



48. Leaf entirely glabrous.
49. Leaf 7–12 cm long, nerves 5–7 pairs; nut to 3 by 1.3 cm, drying mauve tomentose . . . . . 46. *S. balanocarpoides*
49. Leaf less than 8 cm long, nerves 7 or more pairs; nut to 2 by 1.2 cm, cream-buff tomentose or glabrous.
50. Nerves 8–10 pairs, hardly raised beneath; leaf base cuneate but not decurrent at petiole insertion; petiole drying rugulose, black; style without distinct stylopodium . . . . . 47. *S. multiflora*
50. Nerves 7–9 pairs, slender but distinctly raised beneath; leaf base cuneate, somewhat decurrent; petiole drying smooth, black; style with distinct stylopodium . . . . . 48. *S. patoiensis*
46. Leaf at least twice as long as broad.
51. Leaf grey-brown scabrid tomentose beneath; base cordate . . . . . 49. *S. induplicata*
51. Leaf not as above.
52. Nerves and midrib sunken in shallow furrows above . . . . . 50. *S. subcylindrica*
52. Leaf nervation not as above.
53. Leaf nervation pubescent beneath.
54. Leaf base equal; midrib prominently depressed, obscure, above . . . . . 51. *S. obovoidea*
54. Leaf base unequal, midrib not as above . . . . . 52. *S. chaiana*
53. Leaf nervation glabrous beneath.
55. Petiole persistently pale cream puberulent throughout.
56. Petiole exceeding 19 mm long, leaf undersurface matte, lepidote; stamens 10; fruit calyx = patent . . . . . 53. *S. collaris*
56. Petiole to 15 mm long; leaf undersurface and fruit calyx not as above.
57. Petiole 6–8 mm long; flower buds to 2.5 mm long; stamens 15; panicle to 10 cm long . . . . . 54. *S. angustifolia*
57. Petiole exceeding 10 mm long; flower buds exceeding 12 mm long; stamens 10; panicles to 7 mm long. . . . . 55. *S. maxima*
55. Petiole epilose, exceeding 8 mm long.
58. Leaf undersurface matte, distal end of petiole cream . . . . . 56. *S. tenuiramulosa*
58. Leaf undersurface lustrous; petiole drying entirely black.
59. Nerves at most 6 pairs . . . . . 57. *S. conica*
59. Nerves at least 9 pairs.
60. Leaf coriaceous, midrib applanate above . . . . . 58. *S. bakoensis*
60. Leaf thin, midrib elevated above . . . . . 59. *S. xanthophylla*
41. Fruit calyx lobes unequal, 3 prolonged, thin, spatulate, greatly exceeding the nut.
61. Leaf large, thickly coriaceous, with 14–16 pairs of slender nerves and tertiary nerves equally elevated on each surface . . . . . 60. *S. blumutensis*
61. Leaf not as above.
62. Petiole at least 19 mm long, nerves at least 10 pairs.
63. Petiole 3–4 mm  $\varnothing$ , stout; leaf thickly coriaceous . . . . . 61. *S. iliasii*
63. Petiole to 2 mm  $\varnothing$ , slender; leaf chartaceous . . . . . 62. *S. faguetioides*
62. Petiole less than 18 mm long or, if longer, than nerves less than 9 pairs.
64. Nerves 14–19 pairs . . . . . 63. *S. alutacea*
64. Nerves at most 12 pairs.
65. Leaf nervation beneath persistently tomentose.
66. Leaf undersurface densely pale grey-green pubescent . . . . . 64. *S. longisperma*
66. Leaf undersurface glabrous but for nervation.
67. Leaf margin revolute, nerves 9–12 pairs, tomentum scabrid . . . . . 65. *S. acuminatissima*
67. Leaf margin not revolute, nerves 7–9 pairs, tomentum even . . . . . 66. *S. gibbosa*
65. Leaf nervation beneath fugaceous puberulent or glabrous.
68. Leaf nerves very slender, hardly raised beneath, with distinct secondaries; midrib drying reddish or blackish, frequently with a pair of glabrous domatia at base . . . . . 67. *S. hopeifolia*
68. Leaf not as above.
69. Petiole 17–22 mm long, nerves 7–9 pairs . . . . . 68. *S. kudatensis*
69. Petiole at most 16 mm long.
70. Nerves 5–7 pairs . . . . . 69. *S. cuspidata*
70. Nerves 8 or more pairs.
71. Nerves c. 8 pairs, prominently raised beneath . . . . . 70. *S. mujongensis*
71. Nerves 9–12 pairs, hardly raised beneath . . . . . 71. *S. faguëtiana*
39. Anthers with 4 pollen sacs.

72. Anthers linear to oblong; filaments lorate or tapering gradually (not tapering abruptly medially); ovary without distinct stylopodium; style at least as long as ovary.
73. Appendage to connective at least as long as anther, frequently scabrous; wood yellow or white, with reticulate vessel arrangement in TS; silica present. Fig. 91B–C, 92. *Spp.* 72–92.
5. *Sect. Anthoshorea*
74. Stamens at least 17.
75. Stamens 17; nerves 20–24 pairs; leaf undersurface pale pink lepidote. . . . . 72. *S. dealbata*
75. Stamens at least 20.
76. Stamens less than 40.
77. Leaves elliptic-oblong; petiole 2–3 cm long; semi-deciduous tree . . . . . 73. *S. farinosa*
77. Leaves elliptic lanceolate or broadly elliptic-ovate; petiole less than 2 cm long; evergreen trees.
78. Nerves at most 14 pairs; leaves broadly elliptic-ovate.
79. Stamens 21–25; tertiary nerves scalariform . . . . . 74. *S. polita*
79. Stamens 25; tertiary nerves subreticulate . . . . . 75. *S. gratissima*
78. Nerves 17–20 pairs; leaves elliptic-lanceolate . . . . . 76. *S. henryana*
76. Stamens more than 45 . . . . . 77. *S. montigena*
74. Stamens 15.
80. Stipules ovate, auriculate, not at first caducous; leaves not usually exceeding 9 by 4.5 cm (in mature trees), with at least 13 pairs of nerves . . . . . 78. *S. assamica*
80. Stipules not as above, caducous; leaves at least 10 cm long or with less than 13 pairs of nerves.
81. Leaf nervation beneath persistently tomentose.
82. Twigs, petioles, and nerves and midrib beneath red-brown to cream-brown pubescent; leaf undersurface bright yellow lepidote . . . . . 79. *S. ochracea*
82. Tomentum dull grey to tawny brown, leaf undersurface dull grey.
83. Leaves typically obovate, with at most 17 pairs of nerves; twigs prominently compressed . . . . . 80. *S. virescens*
83. Leaves typically ovate-oblong; nerves 17–26 pairs; twigs terete.
84. Tomentum short, even; anther thrice as long as broad . . . . . 81. *S. javanica*
84. Tomentum uneven, scabrid; anther twice as long as broad . . . . . 82. *S. lamellata*
81. Leaf nervation beneath early glabrescent.
85. Midrib evident, applanate above; deciduous tree. . . . . 83. *S. roxburghii*
85. Midrib obscure, depressed above; evergreen trees.
86. Fruit calyx lobes vestigial, about twice length of nut . . . . . 84. *S. bentongensis*
86. Fruit calyx lobes at least thrice as long as nut.
87. Nerves at least 15 pairs; twig apices compressed.
88. Petiole at least 2 cm long; leaf undersurface cream lepidote in mature trees . . . . . 85. *S. hypochra*
88. Petiole less than 2 cm long; leaf undersurface not cream lepidote
89. Fruit pedicel c. 1 cm long, c. 5 mm  $\varnothing$ , very stout and prominent; 3 longer fruit calyx lobes to 18 cm long . . . . . 86. *S. symingtonii*
89. Fruit pedicel at most 2 mm long, not prominent; fruit calyx lobes not exceeding 13 cm long.
90. Leaf to 12 by 4.8 cm, narrowly elliptic to lanceolate; base obtuse or broadly cuneate; undersurface coppery lepidote . . . . . 87. *S. retinodes*
90. Leaf at least 8 by 5.5 cm, oblong to obovate; base cordate; undersurface not lepidote . . . . . 88. *S. cordata*
87. Nerves at most 15 pairs or, if more, then twigs terete.
91. Twig apices  $\pm$  compressed; leaf subchartaceous, drying chocolate brown . . . . . 89. *S. bracteolata*
91. Twigs terete; leaf coriaceous, drying tawny to pale yellow-brown.
92. Leaf base cuneate . . . . . 90. *S. resinosa*
92. Leaf base obtuse to cordate.
93. Base of fruit impressed; flower bud to 5 by 2.5 mm. . . . . 91. *S. agamii*
93. Base of fruit tapering; flower bud to 9 by 5 mm . . . . . 92. *S. confusa*
73. Appendage to connective less than  $\frac{1}{2}$  length of anther, short, glabrous. Wood pink, with loose oblique vessel arrangement (in TS); silica absent. Fig. 94, 95. *Spp.* 93–97. 6. *Sect. Rubella*
94. Midrib obscure above; twigs compressed; stamens 20–24 . . . . . 93. *S. albida*
94. Midrib evident above; twigs terete.
95. Stamens at most 20.
96. Stamens 15 . . . . . 94. *S. rubella*
96. Stamens 19–20 . . . . . 95. *S. elliptica*
95. Stamens at least 25.



97. Stamens c. 25 . . . . . 96. *S. dispar*  
 97. Stamens c. 48 . . . . . 97. *S. negrosensis*
72. Anthers broadly oblong to subglobose; appendage to connective vestigial, or shorter than anther and reflexed, or, if long and unreflexed, filaments abruptly tapering  $\pm$  medially or united in a tube round the ovary; stylopodium usually distinct. Wood pink, without silica; pore arrangement oblique, clustered or solitary, variable though never reticulate.
98. Stamens less than 30; filaments compressed and broad at base.
99. Appendage to connective filiform, slender, at least twice as long as anther, not reflexed; filaments broad at base, tapering abruptly and filiform below the anthers.
100. Filaments broad at base, tapering abruptly medially, filiform, not fixed into a distinct tube round the ovary though frequently connate at base; ovary either with a distinct stylopodium and  $\pm$  pyriform, or without and small and ovoid; style filiform. Fig. 91D, 98–100. *Spp.* 98–122.
7. *Sect. Brachypterae*
101. Stamens 24–28. Fig. 98. *Sp.* 98. 7a. *Subsect. Smithiana*  
 Only species. 98. *S. smithiana*
101. Stamens 15. Fig. 91D, 99–100. *Spp.* 99–122. 7b. *Subsect. Brachypterae*
102. Ovary ovoid, stylopodium indistinct or absent; style as long as ovary and stylopodium or longer, frequently  $\pm$  pubescent in the basal half.
103. Leaf base distinctly unequal, midrib curved to one side.
104. Leaf broadly ovate; nerves at most 13 pairs . . . . . 99. *S. inaequilateralis*
104. Leaf oblong-ovate; nerves at least 19 pairs . . . . . 100. *S. selanica*
103. Leaf base equal.
105. Leaf undersurface, petiole and twig scabrid tomentose.
106. Leaf coriaceous, margin revolute, cream lepidote beneath; longer fruit calyx lobes to 6.5 by 1.5 cm . . . . . 101. *S. flemmichii*
106. Leaf  $\pm$  chartaceous, not lepidote beneath; margin not revolute; longer fruit calyx lobes exceeding 10 by 2 cm.
107. Leaf concave . . . . . 102. *S. almon*
107. Leaf applanate . . . . . 103. *S. parvistipulata*
105. Leaf undersurface, petiole, and twig densely shortly evenly pubescent to glabrous.
108. Nerves at least 13 pairs, very slender, hardly elevated beneath; tertiary nerves densely scalariform beneath, unraised.
109. Leaf beneath prominently cream lepidote . . . . . 104. *S. balangeran*
109. Leaf entirely glabrous.
110. Leaf 10–15 by 5–8 cm; base subpeltate, discernible as a rib over the base of the midrib in mature trees; stipule scars cuneate . . . . . 105. *S. coriacea*
110. Leaf 6–10 by 3–5 cm; base not subpeltate; stipule scars amplexicaul . . . . . 106. *S. venulosa*
108. Nerves, if more than 13 pairs, prominent beneath and tertiary nerves not as above.
111. Nerves at least 16 pairs, leaf pinkish cream lepidote beneath . . . . . 107. *S. waltoni*
111. Nerves most 16 pairs and then leaf not pale lepidote beneath.
112. Petiole 4–6 cm long . . . . . 108. *S. pachyphylla*
112. Petiole at most 3.5 cm long.
113. Appendage to connective setose . . . . . 109. *S. pauciflora*
113. Appendage glabrous.
114. Leaves with to 3 pairs of white scale-like domatia at base; style glabrous except at base . . . . . 110. *S. johorensis*
114. Leaves without white scale-like domatia.
115. Fruit calyx lobes short, subequal . . . . . 111. *S. palembanica*
115. Fruit calyx lobes long, aliform, unequal.
116. Leaf undersurface cream lepidote (mature trees); corolla mauve; nut to 14 by 7 mm . . . . . 112. *S. andulensis*
116. Leaf undersurface glabrous; corolla cream; nut to 18 by 14 mm 113. *S. polysperma*
102. Ovary and stylopodium distinctly pyriform, the stylopodium distinct from the style; style not longer than ovary and stylopodium, glabrous.
117. Twigs compressed, nerves hardly raised beneath; midrib sharply acute beneath . . . . . 114. *S. platyclados*
117. Twigs terete, nerves distinctly raised beneath; midrib prominent beneath but not sharp.
118. Fruit calyx lobes relatively short, less than twice as long as ripe nut.
119. Style and stylopodium densely pubescent but for the apex, hardly distinguishable from one another, filiform at the apex, stouter beneath, frequently further swollen in the basal half; ripe nut to 5 by 2.5 cm . . . . . 115. *S. scaberrima*

119. Style and stylopodium well defined; ovary and stylopodium ovoid, crowned by an equally long filiform glabrous style; ripe nut to 3.5 by 1.5 cm . . . . . 116. *S. fallax*
118. Fruit calyx lobes more than 3 times as long as nut. . . . .
120. Style and stylopodium densely pubescent but for the apex . . . . . 117. *S. pubistyla*
120. Ovary and stylopodium crowned by an equally long filiform glabrous style.
121. Stipules large, subsistent, leaving amplexicaul scars . . . . . 118. *S. palosapis*
121. Stipules fugaceous, small, leaving short scars.
122. Appendages exceeding style at anthesis, very slender, crisped; leaf bullate between tertiary nerves; nervation beneath, petiole and twig scabrid tomentose . . . . . 119. *S. bullata*
122. Appendages not exceeding style apex, awn-like; leaf applanate, evenly pubescent or glabrous.
123. Style  $c. \frac{1}{2}$  length of ovary and stylopodium; ovary and stylopodium glabrescent; anthers large, fused, strongly tapering towards apex . . . . . 120. *S. flaviflora*
123. Style  $\pm$  equal in length to ovary and stylopodium; ovary and stylopodium shortly pubescent; anthers not large, not fused, hardly tapering.
124. Nerves 13–16 pairs; leaf undersurface gold lepidote, without domatia . . . . . 121. *S. monticola*
124. Nerves 6–8 pairs; leaf glabrous, with pore-like domatia . . . . . 122. *S. kunstleri*
100. Filaments united in a tube around the base of the ovary, tapering abruptly near apex; stylopodium merging into style; style and stylopodium spindle-shaped, narrow and tapering at base and apex; or stylopodium indistinct, style at least twice as long as ovary, filiform. Fig. 103, 104. *Spp. 123–132.*
- 8. Sect. Pachycarpae**
125. Stipule scars amplexicaul.
126. Leaf densely gold-brown tomentose beneath . . . . . 123. *S. pilosa*
126. Leaf shortly sparsely tomentose beneath or glabrous.
127. Stipule with cordate subequal base . . . . . 124. *S. splendida*
127. Stipule not cordate.
128. Nerves 11–20 pairs; nut to 6 by 4 cm, relatively large; fruit calyx lobes to 11 cm long; relatively short.
129. Panicles to 35 cm long, axillary on modified parts of twigs with short internodes, the subtending leaves mainly abortive; stipules to 2 cm long, subrevolute . . . . . 125. *S. stenoptera*
129. Panicles to 20 cm long, borne in axils of normal leaves on normal twig; stipule to 5 cm long, applanate . . . . . 126. *S. macrophylla*
128. Nerves 9–12 pairs; nut to 3.7 by 2.5 cm, relatively small; fruit calyx lobes exceeding 15 cm long, relatively long. . . . . 127. *S. praestans*
130. Leaf 25–35 cm long . . . . .
130. Leaf 11–21 cm long. . . . .
131. Leaf broadly ovate to suborbicular, 10–13 cm wide . . . . . 128. *S. rotundifolia*
131. Leaf elliptic, 5–8 cm wide . . . . . 129. *S. amplexicaulis*
125. Stipule scars not amplexicaul.
132. Leaf base cordate, undersurface densely persistently golden pubescent; nerves 16–20 pairs . . . . . 130. *S. mecistopteryx*
132. Leaf base not cordate; tomentum not as above or leaf glabrous.
133. Stipule scars short,  $\pm$  straight or slightly up-pointing; nerves 11–14 pairs . . . . . 131. *S. beccariana*
133. Stipule scars falcate, down-curved; nerves normally 14–19 pairs. . . . . 132. *S. pinanga*
99. Appendage to connective shorter than, or as long as, anther, becoming reflexed; filaments tapering gradually from base to anther. Fig. 106, 107. *Spp. 133–159. 9. Sect. Mutica*
134. Fruit calyx lobes auriculate at base. Fig. 107. *Spp. 133–138. 9a. Subsect. Auriculatae*
135. Leaf narrowly oblong; nerves 19–37 pairs. . . . .
136. Leaf concave, nerves depressed above . . . . . 133. *S. slootenii*
136. Leaf applanate.
137. Nerves 24–28 pairs; leaf beneath sparsely tufted tomentose or glabrescent . . . . . 134. *S. myrionerva*
137. Nerves 19–25 pairs; leaf beneath densely shortly persistently pink-brown scabrid tomentose . . . . . 135. *S. sagittata*
135. Leaf elliptic-ovate to lanceolate; nerves 10–15 pairs.
138. Leaf 7–16 by 2.2–6 cm. . . . .
139. Leaf undersurface lustrous, nerves prominent . . . . . 136. *S. macroptera*
139. Leaf undersurface matte, nerves hardly raised . . . . . 137. *S. ferruginea*
138. Leaf 14–26 by 6.5–12 cm, thickly coriaceous . . . . . 138. *S. acuta*



134. Fruit calyx lobes not auriculate. Fig. 106. *Spp.* 139–159. **9b. Subsect. Mutica**
140. Stipules exceeding 20 mm long, broad, boat-shaped, coriaceous, lustrous, not at first caducous; leaves unequal, ovate, glabrescent beneath.
141. Nerves 4–5 pairs . . . . . 139. *S. quadrinervis*
141. Nerves 7–10 pairs . . . . . 140. *S. acuminata*
140. Stipules less than 20 mm long, thin,  $\pm$  applanate.
142. Flower buds at least 14 mm long, large.
143. Petiole to 6 mm long; leaf base cordate, unequal . . . . . 141. *S. macrantha*
143. Petiole 6–12 mm long; leaf base obtuse, equal . . . . . 142. *S. hemsleyana*
142. Flower buds at most 10 mm long.
144. Fruit calyx lobes less than twice as long as nut . . . . . 143. *S. singkawang*
144. Longer fruit calyx lobes more than three times as long as nut.
145. Leaf undersurface entirely glabrous.
146. Leaf apex retuse . . . . . 144. *S. retusa*
146. Leaf apex acuminate.
147. Nerves 14–16 pairs; stipule to 20 mm long, subsistent . . . . . 145. *S. lepidota*
147. Nerves at most 12 pairs; stipules to 8 mm long, fugaceous.
148. Nerves 8–9 pairs, with prominent axillary pore-like domatia . . . . . 146. *S. foraminifera*
148. Nerves 11–12 pairs, with only a few pairs of small domatia at the base of the midrib . . . . . 147. *S. teysmanniana*
145. Leaf undersurface sparsely or densely tomentose, or cream lepidote.
149. Leaf with at least 14 pairs of nerves or, if 12–13, with cream pubescent undersurface or with pale scale-like domatia up either side of the midrib.
150. Leaf evenly pinkish velutinate beneath; nerves 20–25 pairs, with prominent secondaries . . . . . 148. *S. argentifolia*
150. Leaf tomentum not as above; nerves 14–21 pairs, without secondaries.
151. Leaf beneath, petiole and twigs densely fulvous scabrid tufted tomentose.
152. Leaf prominently concave, chartaceous; petiole 22–32 mm long . . . . . 149. *S. uliginosa*
152. Leaf applanate, coriaceous; petiole 13–23 mm long . . . . . 150. *S. rugosa*
151. Tomentum not as above, young tree leaf with prominent pale domatia up each side of the midrib.
153. Mature tree leaf cream pubescent beneath; nerves 12–15 pairs . . . . . 151. *S. leprosula*
153. Mature tree leaf sparsely scabrid beneath; nerves 16–20 pairs . . . . . 152. *S. platycarpa*
149. Leaf with at most 13 pairs of nerves; domatia and indumentum not as above.
154. Leaf narrowly ovate to lanceolate,  $\pm$  cream to pink lepidote beneath; nerves slender, hardly raised beneath; midrib acute beneath . . . . . 153. *S. curtisii*
154. Leaf elliptic or broadly ovate, undersurface not as above; nerves prominent beneath.
155. Leaf lustrous beneath.
156. Leaf 5–9 by 3–5 cm, elliptic, frequently retuse; margin hardly or not revolute . . . . . 154. *S. scabrida*
156. Leaf 10–15 by 5.5–10 cm, broadly ovate, acuminate, with revolute margin . . . . . 155. *S. revoluta*
155. Leaf not lustrous beneath.
157. Leaf broadly ovate; nerves 8–10 pairs . . . . . 156. *S. ovata*
157. Leaf ovate to elliptic; nerves c. 11 pairs.
158. Leaf beneath, petiole and twigs densely evenly vinous tomentose . . . . . 157. *S. rubra*
158. Leaf beneath, petiole and twigs sparsely pale brown pubescent . . . . . 159. *S. parvifolia*
98. Stamens 50–70, appendage to connective vestigial, filaments filiform. Fig. 115. *Sp.* 160.
10. *Sect. Ovalis*, 160. *S. ovalis*

### 1. Section Shorea

ASHTON, Gard. Bull. Sing. 20 (1963) 265; Man. Dipt. Brun. (1964) 116. — *Shorea* sect. *Eushorea* BRANDIS. J. Linn. Soc. Bot. 31 (1895) 79. — *Shorea*, *Balau* group SYM. Mal. For. Rec. 16 (1943) 14. — **Fig. 78, 82.**

*Flowers* cream, often pink at base. *Stamens* 20–60, in several verticils; filaments broad at base, gradually tapering; anthers with 4 pollen sacs.  $\pm$  broadly oblong.

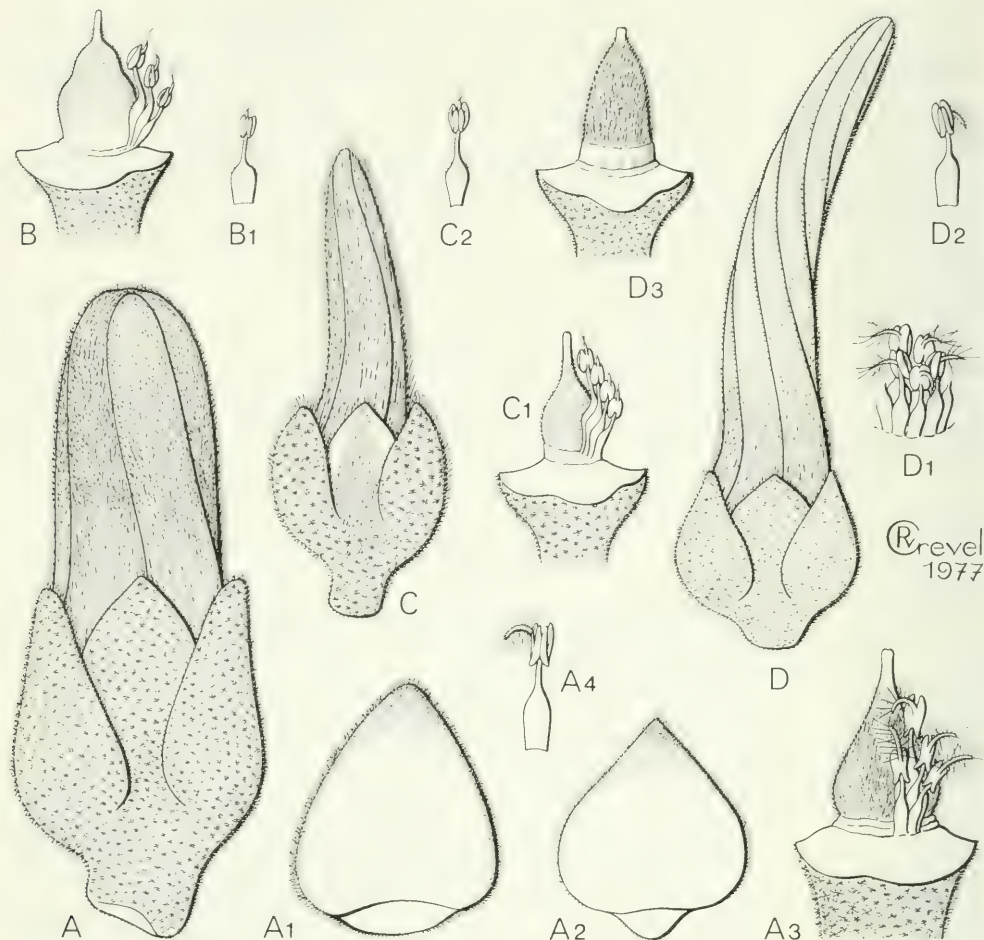


Fig. 78. Flower details in *Shorea* sect. *Shorea* subsect. *Shorea*. All  $\times 10$ . — *S. atrinervosa* SYM. A. Bud, A1. outer sepal, A2. inner sepal, both from inside, A3. stamens and pistil. — *S. brunnescens* ASHTON. B. Stamens and pistil, B1. stamen from inside. — *S. scrobiculata* BURCK. C. Bud, C1. stamens and pistil, C2. stamen from inside. — *S. hypoleuca* MEIJER. D. Bud, D1. stamens from outside, D2. stamen from inside, D3. pistil (A SAN 27274, B SMYTHIES 15218, C BRUN 740, D BAKAR 36229).

cells attenuate at base and apex; appendages shorter than anthers, with 1– $\infty$  bristles. *Ovary* tomentose, with stylopodium. *Stipules* and *bracts* fugaceous, small. *Leaf* with scalariform tertiary nerves; midrib raised or depressed above, always evident. Trees with narrow prominent buttresses. *Bark* surface flaky or dippled (*S. biawak* excepted); radially oblique stone-cell fingers often present; phelloderm pale, thick, conspicuous; expansion tissue in short fingers, more numerous towards outer surface.

Vern. *Balau* (Mal., Sum.), *sēlangan batu* (Borneo, Mal.), *tēkam* (Dayak), *yakal* (Philippines).

Note. The species are, with adequate material well defined and most vary little geographically.



1a. Subsection *Shorea*

*Saul* ROXB. ex W. & A. Prod. (1834) 84, *nomen*. — *Isoptera* SCHEFF. ex BURCK. — *Ridleyinda* O. K. — *Shorea* sect. *Isoptera* (SCHEFF. ex BURCK) FOXW. Philip. J. Sc. 67 (1938) 291, 301; SLOOT. Bull. Bot. Gard. Btzig 17 (1941) 116. — *Shorea ciliata* subgroup SYM. Mal. For. Rec. 16 (1943) 5. — **Fig. 78.**

Flower buds elongate. Petals linear, falling separately. Appendage to connective with few bristles.

Distr. Southern India and Ceylon to Indochina and through *Malesia* to the Moluccas.

Ecol. Evergreen, semi-evergreen and savanna (*S. robusta* of India, *S. obtusa* of S.E. Asia) forests, especially below 1000 m and always below 1500 m. Only *S. robusta*, the *sal*, can be strictly gregarious, most being scattered on well drained soil and river banks.

Note. *S. sumatrana* has been observed to be thrips pollinated and this is likely to be so with other species.

**1. *Shorea collina*** RIDL. Agr. Bull. Str. & F.M.S. 9 (1910) 182; Fl. Mal. Pen. 1 (1922) 231; BURN-MURDOCH, Trees and Timbers Mal. Pen. 1 (1911) 13; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 299; *ibid.* ed. 2 (1927) 1116; FOXW. Mal. For. Rec. 3 (1927) 63, *p.p.*; *ibid.* 10 (1932) 173, *p.p.*; SYM. Gard. Bull. S. S. 9 (1935) 270, pl. 18; Mal. For. Rec. 16 (1943) 12, f. 6, 7. — *S. angustiloba* FOXW. Mal. For. Rec. 10 (1932) 168, pl. 11; SYM. *apud* DESCH, Mal. For. 3 (1934) 195; SYM. Mal. For. 4 (1935) 26.

Medium-sized or large tree. Stipules outside, leaf bud, parts of petals exposed in bud, ovary and panicles persistently densely shortly evenly buff pubescent, twig and sepals caducously so, panicle sparsely caducously so. *Twigs* c. 3 mm  $\varnothing$  apically, stout, ribbed at first, becoming terete, smooth, blackish; stipule scars obscure, falcate, downcurved. *Buds* to 3 by 2 mm, ovoid, acute. *Stipules* to 10 by 5 mm, lanceolate, acute, caducous. *Leaves* 9–21 by 5–13 cm, broadly elliptic-oblong, coriaceous; base obtuse to cordate; apex obtuse, acute or with short broad acumens; nerves 11–15 pairs, slender but prominent beneath, arched, at to 90° at the base, down to 30° near the apex; tertiary nerves very slender, densely scalariform; midrib applanate above, prominent and terete beneath; *petiole* 2–4 cm long, stout. *Panicle* to 4 cm long, terminal or axillary, slender; singly branched, branchlets to 1 cm long, bearing to 3 second flowers. *Flower buds* to 8 by 4 mm, fusiform; sepals broadly ovate, subequal, submucronate; *stamens* c. 55, subequal; filaments broadly dilated and connate at base, tapering; anthers narrowly oblong, glabrous; appendages somewhat exceeding anthers, with 2–5 prominent apical bristles; *ovary* broadly ovoid; style short, columnar. *Fruit pedicel* by 2 by 3 mm, stout; *calyx lobes* vestigial; 3 longer lobes to 5 by 1.3 cm, obtuse, spatulate, c. 6 mm wide above the to 1.7 by 1.4 cm ovate somewhat thickened saccate base; 2 shorter lobes to 2.5 by 0.5 cm apically, otherwise similar; *nut* to 3.5 by 2.5 cm, large, crowned by a to 8 mm long tapering style remnant.

Distr. *Malesia*: Malaya (E. coast from Trengganu southwards).

Ecol. Low lying land; local.

Vern. *Balau merah*, *b. bukit*, *b. tiong*, *sēlimbar*, *tērbak*, *tēngkawang batu*.

**2. *Shorea ochrophloia*** [SYM. *apud* DESCH, Mal. For. Rec. 4 (1935) 28, *nomen*] STRUGNELL ex SYM. Gard. Bull. S. S. 8 (1935) 268, pl. 17; Mal. For. Rec. 16 (1943) 23, f. 15.

Large buttressed tree. Twigs, buds, stipules, petioles, panicles, sepals, part of petals exposed in bud, ovary, midrib above and leaves beneath persistently densely shortly dark golden-brown scabrid pubescent. *Twig*. c. 2 mm  $\varnothing$  apically, terete, becoming blackish, rugulose to smooth. *Bud* to 4 by 3 mm, ellipsoid, subacute. *Stipules* to 10 by 5 mm, oblong-elliptic, obtuse, early caducous. *Leaves* (4–)6–12 by 3.5–6.5 cm, ovate to elliptic-oblong, coriaceous; margin frequently revolute; base obtuse to subcordate; apex obtuse, acute or with a short broad acumens; nerves 13–18 pairs, prominent beneath,  $\pm$  depressed above, set at 80° at the base but down to 25° near the apex; tertiary nerves slender, scalariform; midrib prominent and terete beneath, somewhat depressed above; *petiole* 7–17 mm long, short, geniculate. *Panicle* to 6 cm long, terminal or axillary, short, terete; singly branched, branchlets bearing to 6 flowers; *bracteoles* fugaceous, unknown. *Flower buds* to 7 by 2 mm, fusiform. *Sepals* ovate, the 3 outer subacute, the 2 inner subacuminate. *Petals* cream with a deep pink patch at the base within. *Stamens* 30, subequal, filaments tapering, compressed; anthers oblong, glabrous; appendage exceeding anther apex, with to 5  $\pm$  prominent bristles; *ovary* with distinct stylopodium, both pubescent; style short but prominent. *Fruit pedicel* to 2 by 2 mm. 3 longer *calyx lobes* to 7 by 1.5 cm, spatulate, obtuse, c. 5 mm broad above the to 7 by 5 mm ovate saccate thickened base; 2 shorter lobes to 6 by 0.7 cm, otherwise similar. *Nut* to 2 by 1 cm, narrowly ovoid, tapering to an up to 3 mm long columnar style.

Distr. *Malesia*: Malaya, W. Sumatra (Painan).

Ecol. Scattered, local, on well drained undulating land and old alluvium below 350 m.

Vern. *Sēraya batu*.

Note. A local segregate of *S. guiso*, with which it now nevertheless grows in mixture without apparent hybridisation.

**3. *Shorea guiso*** (BLCO) BL. Mus. Bot. Lugd.-Bat. 2 (1852) 34; WALP. Ann. 4 (1857) 338; DC. Prod. 16, 2

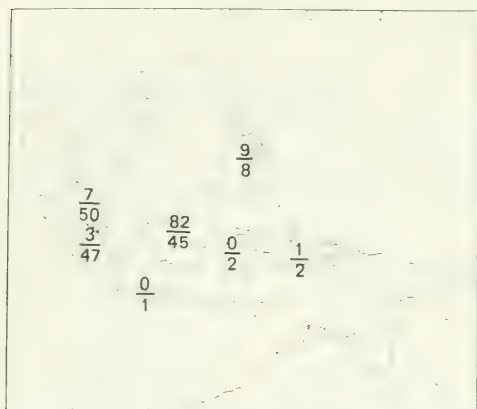


Fig. 79. Density map of *Shorea* ROXB. ex GAERTN. f. in Malasia; number of endemics above the hyphen, number of non-endemics below it.

(1868) 632; VIDAL, Sinopsis (1883) t. 15C; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 89; PERK. Fragm. Fl. Philip. (1904) 23; MERR. Philip. J. Sc. 1 (1906) Suppl. 98; Sp. Blanc. (1918) 270; En. Philip. 3 (1923) 97; FOXW. Philip. J. Sc. 2 (1907) Bot. 384; *ibid.* 4 (1909) Bot. 509; *ibid.* 6 (1911) Bot. 272; *ibid.* 13 (1918) Bot. 191; Mal. For. Rec. 10 (1932) 175; Philip. J. Sc. 67 (1938) 292; EVERETT & WHITFORD, Bull. Bur. For. Philip. 5 (1906) 16; MERRITT & WHITFORD, *ibid.* 5 (1906) 36; MERRITT, *ibid.* 8 (1908) 48; WHITFORD, Philip. J. Sc. 4 (1910) Bot. 703; Bull. Bur. For. Philip. 10 (1911) 71; REYES, Philip. J. Sc. 22 (1923) 337; SLOOT, in Merr. Pl. Elm. Born. (1929) 203; DESCH, Mal. For. 4 (1935) 29; Mal. For. Rec. 12 (1936) 20; SYM. Gard. Bull. S. S. 8 (1935) 266, pl. 16; Mal. For. Rec. 16 (1943) 16, f. 11; BROWNE, For. Trees Sarawak & Brunei (1955) 153; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 171, f. 18; ASHTON, Man. Dipt. Brun. Suppl. (1968) 71. — *Euphoria malaanonan* BLCO, Fl. Filip. ed. 1 (1837) 286. — *Mocanera guiso* BLCO, Fl. Filip. ed. 1 (1837) 449. — *Dipterocarpus guiso* BLCO, Fl. Filip. ed. 2 (1845) 313; DC. Prod. 16, 2 (1868) 614; BLCO, Fl. Filip. ed. 3, 2 (1878) 215. — *Euphoria vel Nephelium* BLCO, Fl. Filip. ed. 2 (1845) 200; *ibid.* ed. 3, 2 (1878) 9. — *Anisoptera guiso* DC. Prod. 16, 2 (1868) 616. — *S. pierrei* HANCE, J. Bot. 16 (1878) 302; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 81. — *S. robusta* (non GAERTN. f.) F.-VILL. Nov. App. (1880) 21. — *S. vulgaris* PIERRE ex LANESAN, Pl. Util. Colon. Fr. (1886) 301; PIERRE, For. Fl. Coch. 3 (1889) t. 232; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 81, t. 2, f. 15–16; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 264, 265, fig.; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 300; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 261. — *S. vidaliana* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 83. — *Isoptera burckii* BOERL. Cat. Hort. Bog. 2 (1901) 111; SLOOT, Bull. Bot. Gard. Btzg III, 17 (1941) 117. — *S. obtusa* var. *kohchangensis* HEIM, Bot.

Tidsskr. (1902) 263. — *S. robusta* var. *schmidtii* HEIM, l.c. 263. — *S. warburgii* (non GILG) PERK. Fragm. Fl. Philip. (1904) 23. — *S. longipetala* FOXW. Mal. For. Rec. 10 (1932) 174, t. 13. — *S. scrobiculata* (non BURCK) FOXW. Mal. For. Rec. 10 (1932) 174; SYM. apud DESCH, Gard. Bull. S. S. 8 (1935) 28, 29.

Large buttressed tree. Young parts at first greyish buff pubescent, early caducous except on inflorescence, calyx, corolla outside, ovary and nut; twig apices and stipule outside densely so at first, becoming sparse as parts expand, remaining dense on inflorescence and nut. *Twig*. c. 1 mm  $\varnothing$  apically, slender, smooth, with minute inconspicuous stipule scars. *Bud* to 5 by 3 mm, compressed, ovate-falcate. *Stipule* to 7 by 5 mm, oblong, subacute, caducous. *Leaves* 5.5–14 by 2.5–6 cm, oblong-lanceolate, thinly coriaceous, glabrescent; base obtuse to broadly cuneate, acuminate to 1 cm long, prominent, broad; nerves (11–)15–19 pairs, slender, at 45°–55° to the midrib but up to 90° at the base; tertiary nerves very slender, densely scalariform, frequently obscure; midrib slender, raised beneath, evident but somewhat depressed above; *petiole* 1–1.8 cm long, slender. *Panicle* to 10 cm long, slender, lax, pendent, the branchlets bearing to 5 second flowers; *bracts* and *bracteoles* minute, linear, fugaceous. *Flower bud* to 1 cm long, slender. *Sepals* broadly ovate; outer 3 acute, inner 2 acuminate, with thin margins. *Petals* bright yellow-red at base within, narrowly lanceolate, densely pubescent on parts exposed in bud. *Stamens* 20–28; filaments loriate, tapering, glabrous; anthers narrowly oblong, glabrous, the two outer cells somewhat the larger; appendage c.  $\frac{1}{2}$  as long as anther, with 1–4(–8) long bristles. *Ovary* ovoid-conical, densely pubescent, surmounted by a columnar glabrous style c.  $\frac{1}{2}$  its length. 3 longer *fruit calyx lobes* to 5.5 by 1 cm, spatulate, obtuse, c. 3 mm broad above the to 8 by 5 mm saccate thickened base; 2 shorter lobes to 3 cm long, linear but similar at base. *Nut* to 8 by 5 mm, ovoid, apiculate, hidden by base of calyx lobes.

Distr. Cochinchina, S.E. and Peninsular Thailand; *Malesia*: Malaya, Sumatra (Atjeh, Tapanuli, Palembang), Borneo (mainly in east), Philippines.

Ecol. Scattered in lowland forest on red soils, most common in slightly seasonal climates; rare and confined to limestone hills in W. and Central Borneo.

Uses. The hard red timber is valuable for light construction in the Philippines.

Vern. *Mëmbatu*, *mërbatu*, *lemesa*, *l. kulor*, *l. nerang*, *chëngal pasir*, *mëranti bulu*, *m. pahang*, *rësak samak*, *sëlimbar* (Mal.), *bëraja*, *damar kënuar batu*, *mëranti hitam* (Sumatra), *sëlangan batu mëräh* (Sabah), *pëlapak*, *lauan*, *raru*, *pakulin batu*, *keping burong*, *mënkabang*, *ambam*, *bërukan baju* (S.E. Borneo), *guijo* (Philippines).

4. *Shorea havilandii* BRANDIS, J. Linn. Soc. Bot. 3 (1895) 82; MERR. En. Born. (1921) 405; BROWNE, For. Trees Sarawak & Brunei (1955) 168; ASHTON, Man. Dipt. Brun. (1964) 136, f. 13, pl. 34 (stem); *ibid.* Suppl. (1968) 72, f. 9; MEIJER & WOOD, Sabah For. Rec. 5



(1964) 173. — *Hopea ovalifolia* BOERL. Cat. Hort. Bog. 2 (1901) 102.

Small or medium-sized tree. Twig, petiole, midrib above, buds and stipule on both surfaces  $\pm$  persistently shortly evenly greyish tawny pubescent. *Twig* c. 1 mm  $\varnothing$  apically, terete, slender; stipule scars c. 1 mm long, short, cuneate, horizontal or slightly descending. *Bud* c. 2 by 1.5 mm, ovoid, obtuse. *Stipule* c. 6 by 2.5 mm, oblong, subacute, fugaceous. *Leaves* 8–16 by 3.5–6 cm, thinly coriaceous, ovate-elliptic; base obtuse or broadly cuneate; acumen c. 0.7 cm long, narrow; nerves 9–12 pairs, dense, parallel, slender but prominent beneath, at c. 30°–45° along the lamina, to 80° at the base; with small tomentose domatia; tertiary nerves slender, densely scalariform; midrib grooved; petiole 8–12 mm long. *Panicle* to 12 cm long, terminal or axillary, straight, terete or slightly compressed, shortly sparsely persistently pale brown pubescent; singly branched, the branchlets to 1.5 cm long, short, bearing to 7 second flowers; *bracteoles* to 4 mm long, elliptic, subacute, shortly pubescent, fugaceous. *Flower bud* to 8 by 2.5 mm, lanceolate. *Calyx* shortly pubescent outside, glabrous within; lobes ovate, subacute, the inner 2 somewhat smaller, relatively broader and thinner than the outer 3. *Petals* cream pink at base. *Stamens* 30–50; filaments broad at base, tapering abruptly and filiform distally, glabrous; anthers oblong, the cells tapering, outer cells longer than inner cells; appendages to connective short, glabrous but for a single long apical bristle. *Ovary* broadly ovoid, pubescent. *Fruit calyx* to 10 by 8 mm; lobes subequal, shortly buff-pubescent on both surfaces, thin, ovate, prominently narrowly acuminate, shallowly saccate. *Nut* to 1.5 by 1 cm, globose, obtuse; style remnant c. 2 mm long, slender.

Distr. *Malesia*: Borneo (Sarawak, E. Sabah).

Ecol. Locally abundant in Heath forest and fresh water swamp forest on white and yellow sand, and on peat overlying limestone.

Vern. *Selangan batu pinang*.

**5. *Shorea brunnescens* ASHTON**, Gard. Bull. Sing. 22 (1967) 283, pl. 28; Man. Dipt. Brun. Suppl. (1968) 68, f. 9. — Fig. 78 B–B1.

Medium-sized tree. Leaf bud densely shortly persistently buff pubescent, young twigs and petiole sparsely caducously so; lamina glabrous. *Twig* c. 1 mm  $\varnothing$  towards apex, terete, smooth; stipule scars short, horizontal, obscure. *Bud* to 2.5 by 2 mm, small, ovoid, acute. *Stipules* unknown. *Leaves* 6–12 by 2.5–6 cm, broadly ovate to lanceolate, coriaceous; base broadly cuneate; acumen to 1 cm long, narrow; nerves 9–11 pairs, very slender, hardly raised beneath, curved, at 45°–60°; tertiary nerves dense, subreticulate, evident but hardly raised on either surface; midrib obscure, depressed above, prominent, furrowed, beneath; *petiole* 1–1.5 cm long. *Panicle* to 9 cm long, terminal or axillary, angular, sparsely shortly buff pubescent; singly branched, branchlets to 1.5 cm long; *bracteoles* unknown. *Flowers* second; *buds* to 4 by 2 mm, narrowly ellipsoid. *Calyx* densely pubescent outside,

glabrous within; lobes ovate, acute, the inner two somewhat shorter and relatively broader than the outer 3. *Petals* lanceolate, shortly pubescent on parts exposed in bud. *Stamens* 40–62; filaments glabrous, compressed at base, tapering abruptly and filiform distally, anthers elliptic-oblong, glabrous, the inner 2 sacs somewhat smaller than the outer 2; appendage to connective shorter than anther, glabrous but for up to 2 long apical setae. *Ovary* and *stylopodium* pyriform, densely pubescent, crowned by a short columnar glabrous style. *Mature fruit* unknown: *Fruit calyx* at first greyish pubescent; calyx lobes aliform, unequal, 3 much longer than the other 2.

Distr. *Malesia*: Borneo (W. Sarawak eastwards to Kinabalu, S.E. Borneo northwards to Belajan R.).

Ecol. Locally frequent on skeletal soils on high ridges to 1500 m, also sometimes on leached clay soil on undulating land.

Vern. *Selangan batu tinteng*.

**6. *Shorea scrobiculata* BURCK.** Med. Lands Pl. Tuin 3 (1886) 223; Ann. Jard. Bot. Btzig 6 (1887) 207; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 83; MERR. En. Born. (1921) 406; BROWNE, For. Trees Sarawak & Brunei (1955) 169; ASHTON, Gard. Bull. Sing. 20 (1963) 272; Man. Dipt. Brun. (1964) 144, f. 13; *ibid.* Suppl. (1968) 74. — *S. pierreana* HEIM. Rech. Dipt. (1892) 48. — *S. sp. nov.* SYM. ex DESCH. Mal. For. Rec. 12 (1936) 9. — *S. meadiana* SYM. Gard. Bull. S. S. 10 (1939) 366, pl. 23; Mal. For. Rec. 16 (1943) 22, f. 6; cf. ASHTON, Gard. Bull. Sing. 22 (1967) 282. — Fig. 78 C–C2.

Medium-sized tree. Twig, panicle, leaf bud, stipule and petiole densely shortly buff pubescent; midrib on both surfaces and nerves beneath sparsely dotted with minute hair tufts. *Twig* c. 1.5 mm  $\varnothing$  apically, terete, much branched, slender, smooth, becoming finely rugulose; stipule scars short, pale, horizontal. *Bud* 2–3 by 1–2 mm, ovoid, frequently slightly compressed. *Stipule* c. 7 by 3 mm, hastate, acute, fugaceous. *Leaves* 5.5–11 by 2.5–4 cm, narrowly ovate to oblong-lanceolate; base broadly cuneate; acumen to 1 cm long, narrow; nerves 10–12 pairs, dense, prominent, straight, at c. 35°–55°; midrib slightly depressed above; tertiary nerves densely scalariform, at 90° to the nerves; *petiole* c. 8 mm long. *Panicle* to 7 cm long, terminal or axillary, terete; singly branched, branchlets to 1.5 cm long, short, bearing to 9 second flowers; *bracteoles* to 3 mm long, elliptic, subacute, shortly pubescent. *Flower bud* to 6 by 2 mm, narrowly lanceolate. *Calyx* shortly tomentose outside, glabrous within; lobes ovate, subacute; inner 2 somewhat smaller, relatively broader, thinner, than outer 3. *Petals* pink, cream at margin, linear, pubescent on both surfaces, strongly contorted in bud. *Stamens* 20–30; filaments broad at base, tapering abruptly and filiform distally, glabrous; anthers oblong, glabrous, tapering, the outer cells larger than the inner cells; appendage to connective short, glabrous but for a single (–2) apical bristle. *Ovary* broadly ovoid, pubescent; *stylopodium* narrowly cylindrical, shorter than

the ovary, pubescent; style as long as stylopodium, tapering, glabrous. *Fruit calyx* shortly buff pubescent; 3 longer lobes to 5 by 1.2 cm, spatulate, chartaceous, obtuse, c. 2.5 mm broad above the c. 5 by 4 mm saccate thickened base; 2 shorter lobes to 3.5 by 4 mm, subequal, spatulate, similar at base. *Nut* to 10 by 7 mm, ovoid, densely shortly buff tomentose; style remnant c. 1.5 mm long.

Distr. *Malesia*: Malaya (Perak, Trengganu, Pahang), Borneo (Ulu Kapuas, Sarawak, E. Sabah, W. Kutei, Muaratewe).

Ecol. Undulating land and hills to 700 m, Mixed Dipterocarp forest.

Vern. *Sēlangan batu zang* (Sar.), *palepek gunung* (S.E. Borneo), *balau sēngkawang*, *damar laut kuning* (Mal.).

7. *Shorea leptoderma* MEIJER, Act. Bot. Neerl. 12 (1963) 331, pl. 5; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 180, pl. 14b (stem).

Small to medium-sized tree. Young twigs, leaf buds, parts of petals exposed in bud, ovary, panicles, petioles, stipules outside (sparsely so within) and nervation above (glabrescent beneath) densely evenly shortly persistently pale ochreous pubescent; sepals thus at first, becoming sparse in fruit. *Twig* c. 2 mm  $\varnothing$  apically, ribbed at first, becoming terete, chocolate-brown, minutely pale lenticellate. *Buds* to 3 by 2 mm, ellipsoid, subacute. *Stipules* to 8 by 5 mm, elliptic, obtuse, fugaceous. *Leaves* 4–18 by 1.5–6.5 cm, elliptic, chartaceous; base cuneate; apex acute or with to 1 cm long slender acumen; nerves 7–12 pairs, slender but prominent beneath, arched, at 35°–45°; tertiary nerves slender, scalariform; midrib appanate above, prominent beneath; *petiole* 8–10 mm long. *Panicle* to 10 cm long, ribbed; singly branched, branchlets short, bearing to 8 congested secund flowers; *bracteoles* unknown. *Flower buds* to 5 by 2 mm, lanceolate; sepals broadly ovate, subequal, the outer 3 acute, the inner 2 subacuminate; *stamens* c. 30; filaments compressed, tapering; anthers ellipsoid, glabrous; appendages hardly exceeding anthers, with to 5 long bristles; *ovary* ovoid, with short columnar style. *Fruit pedicel* to 2 mm long, slender; 3 longer *calyx lobes* to 8 by 1.5 cm, spatulate, obtuse, c. 4 mm wide above the to 5 by 5 mm saccate thickened base; 2 shorter lobes to 4.5 by 0.4 mm, linear, acute, otherwise similar. *Nut* to 12 by 6 mm, ovoid, tapering to the 2 mm columnar style remnant.

Distr. *Malesia*: Borneo (N.E. Borneo, Sandakan Distr. and Tawau).

Ecol. Lowland forests.

Vern. *Sēlangan batu biabas*, s. b. *jambu*.

Note. Closely allied to *S. scrobiculata* from which it is doubtfully distinct.

8. *Shorea ciliata* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 118; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 82; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 154, t. 187; RIDL, Fl. Mal. Pen. 1 (1922) 229; FOXW. Mal. For. Rec. 10 (1932) 171; SYM. Mal. For. Rec. 16 (1943) 10, f. 6.

Medium-sized tree. Sepals, ovary and parts of petals exposed in bud densely shortly evenly buff pubescent; young innovations fugaceous cream lepidote, leaf undersurface sometimes sparsely persistently so, otherwise glabrous. *Twigs* c. 2 mm  $\varnothing$  apically, slender, much branched, terete, dark brown, smooth. *Buds* to 3 by 2 mm, ellipsoid, subacute. *Stipules* to 6 mm long, linear, fugaceous. *Leaves* (4–)5–13(–17) by (1.5–)2.5–5(–8) cm, ovate-lanceolate, coriaceous; base cuneate; acumen to 1 cm long, slender; nerves 9–11 pairs, slender, hardly elevated beneath, arched, at 25°–65°; tertiary nerves slender, subreticulate; midrib elevated on both surfaces though more prominent below than above, terete; *petiole* 1.5–2.5 cm long, slender, geniculate. *Panicle* to 10 cm long, terminal or axillary, terete; singly or doubly (if terminal) branched, branchlets to 3 cm long, bearing to 6 flowers; *bracteoles* unknown, fugaceous. *Flower bud* to 8 by 3 mm, lanceolate. *Petals* cream. *Sepals* ovate, subacute, unequal. *Stamens* c. 26–28, subequal; filaments compressed, tapering; anthers oblong, glabrous; appendages short, with to 5 prominent bristles; *ovary* with distinct stylopodium; style short but prominent, glabrous. *Fruit pedicel* to 1 mm, short. 3 longer *fruit calyx lobes* to 6 by 1.5 cm, spatulate, obtuse, to 5 mm wide above the to 8 by 5 mm ovate saccate thickened base; 2 shorter lobes to 3 by 0.4 cm, lorate, obtuse, otherwise similar. *Nut* to 12 by 8 mm, ovoid, tapering to a c. 3 mm long style remnant.

Distr. *Malesia*: Malaya.

Ecol. Widespread in Upper Dipterocarp Forests on ridges of the main range, at 800–1200 m, and down to 300 m on Penang Hill.

Vern. *Balau gunung*.

9. *Shorea submontana* SYM. Gard. Bull. S. S. 10 (1939) 368; Mal. For. Rec. 16 (1943) 24, f. 6. — *S. costata* (non (CORREA) PRESL) KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 119; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 81; BURK. J. Str. Br. R. As. Soc. 81 (1920) 67, 86, fig.; *ibid.* 86 (1922) 281; RIDL, Fl. Mal. Pen. 1 (1922) 231, p.p.; FOXW. Mal. For. Rec. 3 (1927) 67; *ibid.* 10 (1932) 176, p.p.; DESCH, Mal. For. Rec. 12 (1936) 9.

Large buttressed tree. Buds, stipules outside, panicles, parts of petals exposed in bud and ovary shortly densely evenly persistently buff pubescent; sepals thus at first, becoming sparsely so; twigs, petioles, midribs above and nervation beneath caducously so. *Twigs* c. 3 mm  $\varnothing$  apically, ribbed, becoming terete, smooth, blackish. *Buds* to 5 by 3 mm, ellipsoid, obtuse. *Stipules* to 14 by 6 mm, oblong, obtuse, caducous. *Leaves* 7–20 by 4–10 cm, ovate to obovate, thinly coriaceous; base broadly cuneate to cordate; apex acute or with up to 1 cm long, slender acumen; nerves 9–14 pairs, slender but prominent beneath, at 90° at the base, down to 45° towards the apex; tertiary nerves densely scalariform, slender, obscure; midrib prominent, terete, beneath, evident but  $\pm$  appanate above; *petiole* 15–33 mm long, geniculate. *Panicle* to 5 cm long, terete, terminal or axillary, singly branched; *bracts* and *bracteoles* and



mature flowers unknown. *Sepals* broadly ovate, subequal; *stamens* c. 20; filaments compressed, tapering; anthers oblong; appendages exceeding anthers, setose; *ovary* narrowly ovoid; style short, glabrous. *Fruit pedicel* to 1 by 1 mm, short. 3 longer fruit calyx lobes to 9 by 1.8 cm, spatulate, obtuse, c. 6 mm wide above the to 13 by 10 mm ovate saccate thickened base; 2 shorter lobes to 6 by 0.4 mm, lorate, obtuse, otherwise similar. *Nut* to 1.8 by 1.4 cm, ovoid, crowned by an up to 3 mm tapering style remnant.

Distr. *Malesia*: Malaya (Selangor and W. Pahang to Penang and Trengganu).

Ecol. Locally very common on high hills of the main range, usually 800–1000 m, but down to 350 m near coast.

Vern. *Balau gajah*.

**10. *Shorea geniculata* SYM. ex [BROWNE, For. Trees Sarawak & Brunei (1955) 167, *nomen*] ASHTON, Gard. Bull. Sing. 19 (1962) 291, pl. 19; Man. Dipt. Brun. (1964) 133, f. 13, pl. 32 (habit, stem); *ibid.* Suppl. (1968) 71.**

Large tree with stout buttresses. All vegetative parts glabrous. *Twig* c. 3 mm  $\varnothing$  apically, stout, much branched, terete, smooth; nodes prominent, with raised round petiole scar and c. 2–3 mm long straight pale linear ascending stipule scars (only visible on young twigs). *Bud* 4–7 by 1–1.5 mm, linear to falcate. *Stipule* to 10 by 3 mm, narrowly oblong, acute, caducous. *Leaves* 11–17 by 7–13 cm, broadly ovate to suborbicular, cream lepidote beneath, coriaceous; base obtuse or subcordate; acumen to 8 mm long; nerves 9–11 pairs, distant, arched, at c. 40°–50°; tertiary nerves sinuate, densely scalariform, slender; *petiole* 4–6 cm long. *Panicle* to 12 cm long, terminal or axillary,  $\pm$  terete, densely shortly persistently pale buff pubescent, glabrescent; regularly singly branched, branchlets to 1.5 cm, short, bearing to 4 second flowers; *bracteoles* to 4 mm long, oblong, puberulent, fugaceous. *Flower buds* to 20 by 4 mm, large, narrowly lanceolate, acute. *Calyx* shortly pubescent outside, glabrous within; lobes ovate, acute, the outer 3 slightly longer and narrower than inner 2. *Petals* cream, to 2.5 cm long, linear, pubescent on both surfaces. *Stamens* c. 55; filaments broad at base, tapering and filiform distally; anthers oblong, glabrous, the posterior lobes slightly smaller; appendage to connective somewhat shorter than anther but prominent, stout and setose. *Ovary* broadly ovoid, densely tomentose but for the glabrous base, abruptly tapering to a short broad trifurcate glabrous style; stigma minute. *Fruit calyx lobes* c. 1.5 cm long and broad, equal, deltoid, subacute, incrassate, sparsely pale grey-buff pubescent, the apices adpressed to the base of the nut. *Nut* to 5 by 5 cm, globose, very large, densely shortly grey-buff tomentose, ridged longitudinally and transversely rugose when dry, shortly mucronate.

Distr. *Malesia*: Borneo (Sarawak and Brunei).

Ecol. Very local, on deep leached yellow soils in Mixed Dipterocarp Forest on subcoastal hills.

Vern. *Upun pënyau* (Brun.).

**11. *Shorea seminis* (DE VRIESE) SLOOT. in Merr. Pl. Elm. Born. (1929) 204; Bull. Bot. Gard. Btzig III, 17 (1941) 117; DAKKUS, Bull. Jard. Bot. Btzig III, Suppl. 1 (1930) 268; FOXW. Mal. For. Rec. 10 (1932) 237; Philip. J. Sc. 67 (1938) 301; BAL, Landbouw 9 (1934) 275; BURK. Kew Bull. (1935) 317; ROWAAN, Landbouw 13 (1937) 310; Bericht n. 13 Afd. Handelsmus. Kol. Inst. (1937) 5; BROWNE, For. Trees Sarawak & Brunei (1955) 170; ASHTON, Gard. Bull. Sing. 20 (1963) 272; Man. Dipt. Brun. (1964) 145, f. 13; *ibid.* Suppl. (1968) 75; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 185, f. 2d, pl. 17 (habit). — *Hopea seminis* DE VRIESE, Minyak Tengkwang (1861) 32; T. & B. Cat. Hort. Bog. (1866) 202. — *Hopea lanceolata* DE VRIESE, Minyak Tengkwang (1861) 32. — *S. schefferiana* HANCE, J. Bot. 16 (1878) 303; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 82; MERR. En. Born. (1921) 406. — *Isoptera borneensis* SCHEFF. ex BURCK, Med. Lands Pl. Tuin 3 (1886) 27; Ann. Jard. Bot. Btzig 6 (1887) 222, t. 25; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 106, p.p.; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 263; BOERL. Cat. Hort. Bog. 2 (1901) 110; BECC. For. Born. (1902) 155, 192, 571; Wand. (1904) 92, 124, 390; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 310; FOXW. Philip. J. Sc. 13 (1918) Bot. 194, pl. 1; MERR. En. Born. (1921) 407; En. Philip. 3 (1923) 101; REYES, Philip. J. Sc. 22 (1923) 301; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 259; DEN BERGER & ENDERT, Med. Proefst. Boschw. 11 (1925) 117; ENDERT, M.O. Born. Exp. (1927) 204, 289, 311; HEYNE, Nutt. Pl. ed. 2 (1927) 1113, 1114, 1127; WATSON, Mal. For. Rec. 5 (1928) 45, 205, p.p.; SLOOT. Bull. Bot. Gard. Btzig III, 17 (1941) 117. — *S. borneensis* PIERRE, For. Fl. Coch. 3 (1889) t. 234. — *Ridleyinda borneensis* O. K. Rev. Gen. Pl. 1 (1891) 65. — *Hopea ovalifolia* (non BOERL.) FOXW. Philip. J. Sc. 6 (1911) Bot. 263; *ibid* 13 (1918) Bot. 183. — *Isoptera seminis* BURK. Kew Bull. (1935) 317; Dict. (1935) 1254; BACKER & BAKH. f. Fl. Java 1 (1963) 332.**

Medium-sized to large tree. *Twig*, *panicle*, *leaf bud*, *stipule*, *petiole*, *midrib* on both surfaces and nerves beneath shortly evenly pale grey-brown pubescent. *Twig* c. 1.5 mm  $\varnothing$  apically, straight, slender, frequently ribbed when young; stipule scars to 1 mm long, short, descending. *Bud* 1.5–2.5 by 1–2 mm, slightly compressed, ovoid to falcate, acute. *Stipule* to 7 by 3.5 mm, oblong, obtuse, caducous. *Leaves* variable in size, 9–18 by 2.5–8 cm, oblong-ovate to lanceolate, glabrous or greyish lepidote beneath, thinly coriaceous; base obtuse or cuneate; acumen 0.8–2 cm long, narrow; nerves 9–15 pairs, slender, rather straight, prominent beneath, at c. 40°–55°; tertiary nerves slender, densely scalariform, sinuate; *petiole* 1–1.5 cm long. *Panicle* to 10 cm long, terminal or axillary to ramiflorous, terete, drying angular; regularly singly branched, branchlets to 1.7 cm long, bearing to 5 second flowers; *bracteoles* linear, shortly pubescent, fugaceous. *Flower bud* to 8 by 2 mm, narrowly lanceolate. *Calyx* shortly pubescent outside,



Fig. 80. *Shorea sumatrana* (SLOOT. ex THORENAAR) SYM. ex DESCH; tree c. 30 m high. Palembang (Photogr. THORENAAR, 1924).



glabrous within; lobes subequal, ovate, obtuse, the inner 2 somewhat narrower and thinner than the outer 3. *Petals* cream, pink towards base, linear, hardly contorted, shortly tomentose outside, glabrous within; *stamens* 30–40; filaments compressed at base, tapering, with a few long bristles; anthers oblong, glabrous, the outer cells larger than the inner cells; appendage to connective short, setose. *Ovary* and *stylopodium* conical to hour-glass shaped, densely pubescent; style short, glabrous. *Fruit calyx* shortly sparsely greyish buff pubescent, lobes subequal, to 2 by 1.8 cm (usually c. 1.5 by 1.4 cm), incrassate, orbicular, rotate. *Nut* c. 1 cm long and  $\varnothing$ , ovoid or globose; style remnant to 12 mm long, stout.

Distr. *Malesia*: Borneo, Philippines.

Ecol. Alluvium banks of sluggish river, often gregarious.

Uses. The fruit are prepared in Borneo as a source of illipe butter, but are too small to be valued for export.

Vern. *Isokabang chengai*, *e. tēgelam*, *e. tērindak*, *e. mayoh*, *e. pēlēpak*, *tēkam tēgelam* (Sar.), *sangkawang* (Brun.), *tēngkawang ayer*, *t. batu*, *t. pēlēpak* (*kēlēpak*), *t. tanggoi*, *t. tērēndak*, *t. chēpak* (Indon. Borneo).

**12. *Shorea sumatrana*** (SLOOT, ex THORENAAR) SYM. ex DESCH, Mal. For. 3 (1934) 195; *ibid.* 12 (1936) 9; J. Str. Br. R. As. Soc. 19 (1941) 161; Mal. For. Rec. 16 (1943) 25, f. 6, 16; SLOOT, Bull. Bot. Gard. Btzg III, 17 (1941) 124, f. 17. — *Isoptera borneensis* (non SCHEFF. ex BURCK) KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 129, *p.p.*; RIDL, Trans. Linn. Soc. 3 (1893) 284; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 106, *p.p.*; MERR. En. Born. (1921) 407, *p.p.*; FOXW. Mal. For. Rec. 1 (1921) 71; *ibid.* 2 (1922) 170; *ibid.* 3 (1927) 70; BURK. J. Str. Br. R. As. Soc. 86 (1922) 281, 287; Bot. Gard. Sing. Guide (1925) 22; RIDL, Fl. Mal. Pen. 1 (1922) 245; MERR. En. Philip. 3 (1923) 101, *p.p.*; WATSON, Mal. For. Rec. 8 (1930) 30; BUNTING & MILSUM, Guide Govt. Exp. Plant. Serdang (1931) 122. — *Isoptera sumatrana* SLOOT, ex [ENDERT, Tectona 18 (1925) 73, 78, 135; DEN BERGER & ENDERT, Med. Proefst. Boschw. 11 (1925) 117, t. 15, f. 58, *nomen*] THORENAAR, Med. Proefst. Boschw. 16 (1926) 115, f. 19; HEYNE, Nutt. Pl. ed. 2 (1927) 1127; FOXW. Mal. For. Rec. 10 (1932) 238; BURK. Dict. (1935) 1257. — **Fig. 80, 81.**

Description as in *S. seminis*, but stamens 25.

Distr. Pattani in S.E. Peninsular Thailand and in *Malesia*: Malaya (mainly East Coast Res.), Sumatra.

Ecol. Alluvium banks of sluggish but not brackish rivers, sometimes semi-gregarious.

Vern. *Sēngkawang* (Mal., Sum.), *kēdawang*, *sēngkawang bēsak* (Palembang), *tēngkawang*, *t. ijok*, *t. batu* (Mal.).

Note. Of the characters by which VAN SLOOTEN distinguished this taxon from *S. seminis* only the number of stamens is consistently reliable, and this species is hence of dubious specific status.

**13. *Shorea foxworthyi*** SYM. Gard. Bull. S. S. 8 (1935) 272, pl. 19; Mal. For. Rec. 16 (1943) 14, f. 6, 9; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 169; ASHTON, Man. Dipt. Brun. Suppl. (1968) 70, f. 9. — *S. collina* (non RIDL.) FOXW. Mal. For. Rec. 3 (1927) 63; *ibid.* 10 (1932) 173; SYM. *apud* DESCH, Mal. For. 3 (1934) 195.

Tall buttressed tree. Twigs, petioles, buds and stipules outside (sparsely within) densely shortly evenly persistently golden-tawny pubescent, leaf nervation beneath sparsely caducously so. *Twig* c. 2 by 3 mm  $\varnothing$  apically, somewhat compressed, rugose when dry, becoming smooth, terete; stipule scars short, dark, slender, horizontal. *Bud* to 3 by 2 mm, ellipsoid, obtuse. *Stipule* to 15 by 4 mm, narrowly elliptic to falcate, subacute, caducous. *Leaves* 8–13 by 3–6.5 cm, elliptic, coriaceous; base broadly cuneate; acumen to 1 cm long, broad; nerves 10–14 pairs, very prominent beneath, appanate or depressed above with the lamina bullate between them, at 85° at the base, 40°–55° towards the apex; tertiary nerves slender, densely scalariform; midrib prominent beneath, somewhat depressed above; *petiole* 11–20 mm long, drying rugose. *Panicle* to 5 cm long, terminal or axillary, short, rugose when dry, persistently evenly shortly golden-tawny pubescent, branchlets bearing to 3 flowers; *bracteoles* fugaceous. *Flower bud* to 10 by 3 mm, fusiform. *Calyx* shortly densely pubescent on parts exposed in bud, the inner 2 lobes fimbriate distally; lobes ovate, acute, the inner 2 somewhat smaller than the outer 3. *Petals* cream, pale carmine at base, linear, shortly densely pubescent outside, sparsely sericeous within. *Stamens* 32–41; filaments comparatively densely setose, compressed at base, tapering distally; anthers narrowly oblong, sparsely setose on the distal margin, the 2 outer cells somewhat the larger; appendage to connective hardly exceeding anther apex, densely setose. *Ovary* ovoid, densely pubescent, surmounted by a similarly tomentose narrowly conical stylopodium and glabrous filiform style; style as long as ovary and stylopodium. *Fruit pedicel* and base of calyx lobes outside sparsely pubescent, nut densely evenly shortly persistently buff pubescent, fruit otherwise glabrous. 3 longer *calyx lobes* to 10 by 2.5 cm, broadly spatulate, obtuse, to 7 mm broad above the to 15 by 12 mm ovate thickened saccate base; 2 shorter lobes to 8 by 1 cm, linear, acute, similar at base. *Nut* to 2.5 by 1.4 cm ovoid; stylopodium to 6 mm long, prominent.

Distr. *Malesia*: Peninsular Thailand, in Malaya (W. coast from Kedah to Selangor; E. coast), Sumatra (N.E. at Langkat), Borneo (Central & N.E. Sarawak, E. Sabah, S.E. Borneo to Puruktau).

Ecol. Scattered, sometimes common, undulating land or hills below 700 m; sandy clay soils.

Vern. *Balau bukit*, *damar laut kuning* (Mal.), *sēlangan batu kuning*, *s. b. bērsisek*, *tēkam* (Borneo).

**14. *Shorea lumutensis*** SYM. Gard. Bull. S. S. 10 (1939) 364, pl. 22; Mal. For. Rec. 16 (1943) 19, f. 6. — *S. ? inappendiculata* (non BURCK) SYM. ex DESCH, Mal.



Fig. 81. Trunk-base of *Shorea sumatrana* (SLOOT. ex THORENAAR) SYM. ex DESCH with some root-climbers ascending, the soil in front carpeted with seedlings. Measuring staff 2 m; same tree as in fig. 80. Palembang (Photogr. THORENAAR, 1924).



For. Rec. 12 (1936) 9, *p.p.*; Govt. Gaz. F. M. S. 29, 26 notice *n.* 5884 (1937), *p.p.*

Medium-sized to large tree. Young twigs and fruit calyx caducous cream puberulent, panicles, parts of perianth exposed in bud, ovary and base of style persistently grey-brown, rough pubescent. *Twigs* *c.* 3 mm  $\varnothing$  apically, terete, drying black. *Stipules* not seen. *Leaves* 7–29 by 2.5–7 cm, oblong or elliptic, coriaceous, persistently cream lepidote beneath, fugaciously so above; margin  $\pm$  sinuate; base cuneate or obtuse; acumen short, broad; nerves 12–16 pairs, obscure above, prominent and drying black beneath; tertiary nerves densely scalariform, sinuate, evident beneath; midrib prominent beneath, evident but  $\pm$  applanate above; *petiole* 2–3.5 cm long, geniculate,  $\pm$  persistently cream lepidote. *Panicle* to 10 cm long, terminal or axillary; singly or (if terminal) doubly branched, branchlets to 1.5 cm long, bearing to 5 secund flowers. *Flower buds* *c.* 9 mm long at anthesis; 3 outer sepals ovate-deltoid, obtuse; 2 inner ovate, acute or acuminate; *stamens* 20–24, of several heights; filaments rather short, broad at base, tapering and filiform beneath the ellipsoid anthers; outer anther cells  $\pm$  sparsely barbate at apices; appendages short, with 1–2 terminal bristles; *ovary* and *stylopodium* ovoid-conical, tapering into the short stout style. *Fruit*  $\pm$  sessile; 3 longer *calyx lobes* to 7 by 1.5 cm, spatulate, obtuse, tapering to *c.* 5 mm above the to 10 by 8 mm elliptic saccate thickened base; 3 shorter lobes to 4.0 by 0.4 mm,  $\pm$  linear, similar at base; *nut* to 20 by 12 mm, ovoid, prominently beaked.

Distr. *Malesia*: W. coastal Malaya (Dindings).

Ecol. Local but common on coastal hills above 100 m.

Vern. *Balau puteh*, *b. bukit*, *damar laut* (Mal.).

Note. Without flowers this species is indistinguishable from the Bornean *S. inappendiculata* BURCK. Sterile specimens from N.W. Johore, Sumatra's E. coast, Karimun and Lingga could belong to either species.

**15. *Shorea exelliptica* MEIJER**, Act. Bot. Neerl. 12 (1963) 323, pl. 1; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 167; ASHTON, Man. Dipt. Brun. (1964) 132, f. 13; *ibid.* Suppl. (1968) 69. — *S. ?elliptica* (non BURCK) SYM. Mal. For. Rec. 16 (1943) 13, f. 6, 8. — *Shorea sp.* BROWNE, For. Trees Sarawak & Brunei (1955) 170.

Tall buttressed tree. Twig, panicle, leaf bud, stipule (short on inner, long on outer surfaces), petiole, midrib on both surfaces and nerves on undersurface densely persistently purplish brown to gold-brown scabrid tomentose; sometimes glabrous on midrib upper surface in mature trees. *Twigs* *c.* 2 mm  $\varnothing$  apically, ridged at first, becoming terete or somewhat compressed, smooth, with *c.* 2 mm long pale linear descending stipule scars. *Bud* to 3.5 by 3 mm, ovoid,  $\pm$  compressed. *Stipule* to 8 by 4 mm, not at first caducous, broadly ovate, acute. *Leaves* 9–15 by 3.5–7 cm, coriaceous, oblong to broadly ovate, golden to silver lepidote beneath; base broadly cuneate; acumen to 1 cm long; nerves 12–18 pairs, prominent beneath,

at *c.* 50°–60°; tertiary nerves slender, sinuate, scalariform; *petiole* 1.2–1.7 cm long, rugose. *Panicle* to 12 cm long, terminal or axillary, ribbed and slightly compressed; singly branched, branchlets to 2.5 cm long, bearing to 8 secund flowers; *bracteoles* to 4 mm long, elliptic, acute, shortly pubescent, fugaceous. *Flower bud* to 10 by 3 mm, narrowly lanceolate. *Calyx* densely pubescent outside, puberulent within; lobes deltoid, subequal. *Petals* cream, pink at base, linear, densely tomentose outside, shortly pubescent within. *Stamens* 30–40; filaments compressed at base, slender, tapering, slightly hispid; anthers oblong, the outer cells somewhat larger than the inner cells; appendage to connective as long as anther, stout, setose. *Ovary* and *stylopodium* shortly ovoid, densely tomentose except at the base; style as long as ovary and stylopodium, slender, glabrous. *Fruit calyx* puberulent to glabrous; 3 longer lobes to 8 by 2.4 cm, spatulate, obtuse, to 4 mm broad above the to 12 by 7 mm ovate thickened saccate base; 2 shorter lobes to 4.5 by 1.7 cm, otherwise similar. *Nut* to 1.5 by 1 cm, ovoid, densely pale grey-buff pubescent; style remnant to 3 mm long.

Distr. *Malesia*: Malaya (Kedah, Perak, E. coast), Borneo.

Ecol. Widespread, leached clay soils on undulating land, ridges and plateaux to 600 m.

Vern. *Balau tēm̃baga* (Mal.), *sēlangan batu tēm̃baga* (N. Borneo).

**16. *Shorea inappendiculata* BURCK**, Ann. Jard. Bot. Btzig 6 (1877) 206; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 102, t. 2, f. 21, 30; MERR. En. Born. (1921) 405; BROWNE, For. Trees Sarawak & Brunei (1955) 171; ASHTON, Man. Dipt. Brun. Suppl. (1968) 73.

Large buttressed tree with flaky bark. Twigs, buds, stipules, petioles, midrib above and panicles densely persistently scabrid rufous pubescent, leaf nervation beneath sparsely so (denser, longer in young trees); leaf undersurface frequently  $\pm$  densely silvery lepidote. *Twig* 2–4 mm  $\varnothing$  apically, blackish, prominently ribbed or compressed at first; stipule scars pale, horizontal. *Bud* to 6 by 4 mm, ovoid, conical; *stipules* to 10 by 4 mm, broadly lanceolate, acute. *Leaves* (7–)10–16 by (2–)3–8 cm (to 30 by 15 cm in young trees), oblong-elliptic, coriaceous; base  $\pm$  unequal, obtuse or cordate; apex shortly acuminate to obtuse; nerves 13–24 pairs, prominent beneath,  $\pm$  distinctly depressed above with the lamina bullate between; tertiary nerves densely scalariform, slightly elevated beneath; midrib prominent beneath, depressed above; *petiole* 15–30 mm long,  $\pm$  stout. *Panicle* to 10 cm long, axillary, ribbed when dry, rather unevenly persistently buff pubescent; singly branched, branchlets to 2 cm long, bearing to 7 secund flowers; *bracteoles* to 3 by 2 mm, elliptic, obtuse, shortly evenly pubescent, fugaceous. *Flower bud* to 7 by 3 mm, fusiform. *Calyx lobes* ovate, densely pubescent on parts exposed in buds, inner sepals fimbriate; 3 outer sepals subacute, larger than the 2 acuminate inner sepals. *Petals* linear, densely pubescent on parts exposed in bud. *Stamens* 28–34; filaments setose

distally abaxially, compressed, tapering; anthers narrowly oblong-elliptic, sparsely setose distally, the 2 outer sacs larger than the 2 inner; appendage to connective as long as anthers on outer stamens, shorter on inner, with a few terminal setae. *Ovary* and *stylopodium* ovoid, densely pubescent, tapering into the short glabrous style. *Fruit pedicel* to 4 by 3 mm, broadening into the receptacle; fruit calyx glabrescent; 3 longer lobes to 13 by 3 cm, broadly spatulate, obtuse, c. 8 mm broad above to 15 by 12 mm ovate saccate thickened base; 2 shorter lobes to 10 by 0.9 cm, lorate, subacute, similar at base; nut to 33 by 16 mm, ovoid, prominently apiculate.

Distr. *Malesia*: Malaya (N.W. Johore), Sumatra (Langkat), Lingga, northern Borneo (Sarawak to E. Sabah and south to Tiding and Muara Tewe).

Ecol. Lowland Mixed Dipterocarp forest on coastal hills and immediately behind the peat swamps; rather rare.

Vern. *Pelepak*, *p. gumong*, *damar pangin*.

Note. See under *S. lumutensis*, with which it is vicarious.

**17. *Shorea falcifera* DYER ex BRANDIS**, J. Linn. Soc. Bot. 31 (1895) 86; BECC. For. Born. (1902) 571; MERR. En. Born. (1921) 571; ASHTON, Gard. Bull. Sing. 31 (1978) 36. — *Hopealingensis* BOERL. Cat. Hort. Bog. 2 (1901) 103. — *S. glauca* (non KING) BROWNE, For. Trees Sarawak & Brunei (1955) 168, *p.p.* — *S. flava* MEIJER, Act. Bot. Neerl. 12 (1963) 325, pl. 2; ASHTON, Man. Dipt. Brun. Suppl. (1968) 69, f. 9. — **Fig. 10.**

Medium-sized tree. Twig, bud, stipule (sparsely so within), nervation and lamina beneath densely persistently pale yellow lepidote. *Twig* c. 1 mm  $\varnothing$  apically, slender, terete, smooth; stipule scars short, horizontal, obscure. *Bud* to 2 by 1 mm, small, ellipsoid, subacute. *Stipule* to 6 by 4 mm, elliptic, obtuse, fugaceous. *Leaf* 6.5–12 by 2.5–5 cm, narrowly ovate to lanceolate, coriaceous; base broadly cuneate, subequal; acumen to 2 cm long, slender; nerves c. 10 pairs, slender, somewhat elevated beneath, applanate above, at 40°–60°; tertiary nerves obscure, scalariform; midrib slender, prominent beneath, shallowly depressed above; *petiole* 11–18 mm long, somewhat geniculate. *Panicle* to 11 cm long, terminal or axillary, terete or ribbed, shortly evenly persistently buff pubescent; singly branched, branchlets to 3 cm long, short, bearing to 5 distichous flowers. *Flower buds* to 8 by 2 mm, fusiform. *Calyx* pubescent on parts exposed in bud; lobes ovate, the two inner subacuminate, somewhat narrower than the outer 3; outer 3 subacute. *Petals* cream, linear, densely pubescent on parts exposed in bud, sparsely so elsewhere. *Stamens* 33–34; filaments setose, compressed at base, tapering and filiform distally; anthers oblong, the two outer cells slightly the larger, sparsely setose on the distal margin; appendage to connective shorter than anther, shortly setose. *Ovary* and *stylopodium* pyriform, densely sericeous, tapering into the short glabrous style. *Fruit pedicel*, base of calyx and nut shortly densely evenly cream pubescent, calyx elsewhere sparsely so. 3 longer

*calyx lobes* to 9.5–1.8 cm, broadly spatulate, obtuse, to 7 mm broad above the to 2 by 1.3 cm ovate thickened saccate base; 2 shorter lobes to 7 by 0.8 cm, narrowly spatulate, obtuse, similar at base. *Nut* to 2.5 by 1.5 cm, ovoid; *stylopodium* to 7 mm, prominent, filiform.

Distr. *Malesia*: Malaya (E. coast: Trengganu, Pahang), N.E. Sumatra (Idi in Atjeh; Langkat; Lingga), Borneo (Sarawak west of K. Lupar).

Ecol. Locally abundant on dry hillslopes near coast.

Vern. *Sĕlangan batu kĕring* (Sar.).

**18. *Shorea materialis* RIDL**, Agr. Bull. Str. & F. M. S. 9 (1910) 183; Fl. Mal. Pen. 1 (1922) 227; BURN-MURDOCH, Tr. Timb. Mal. Pen. 1 (1911) 11; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 306; *ibid.* ed. 2 (1927) 1123; BURK. J. Str. Br. R. As. Soc. 81 (1920) 68; FOXW. Mal. For. Rec. 1 (1921) 69; *ibid.* 3 (1927) 62; *ibid.* 10 (1932) 172; SYM. Mal. For. Rec. 16 (1943) 29, f. 6, 13; ASHTON, Man. Dipt. Brun. (1964) 140, f. 13; *ibid.* Suppl. (1968) 74. — *S. glauca* (non KING) BROWNE, For. Trees Sarawak & Brunei (1955) 168, *p.p.*

Medium-sized tree. Young twig, panicle, leaf bud and petiole caducous cream lepidote. *Twig* 1.5 mm  $\varnothing$  apically, terete, smooth, dark chocolate-brown; stipule scars c. 1 mm long, pale, falcate. *Leaf bud* to 3 by 1 mm, linear, acute. *Stipule* to 12 mm long, linear, fugaceous. *Leaf* 8–15 by 3.5–8.5 cm, broadly ovate, glabrous above, cream lepidote beneath; base cuneate to subcordate, unequal; apex with to 1.5 cm long slender acumen; nerves 9–12 pairs, slender but prominent beneath, set at 30°–45° to the midrib at base, glabrous; tertiary nerves slender, densely scalariform. *Petiole* 1.2–2 cm long, to 2 mm  $\varnothing$ , cream lepidote. *Panicle* to 15 cm long, terminal or axillary, terete or ribbed; singly branched, branchlets to 12 mm long, bearing to 11 secund flowers; *bracteoles* to 2 mm long, ovate, acute, lepidote. *Flower bud* to 10 by 4 mm, lanceolate. *Calyx* sparsely evenly tomentose outside, glabrous within; lobes ovate, subacute, subequal. *Corolla* cream; petals linear, acute, shortly pubescent on parts exposed in bud. *Stamens* c. 30; filaments glabrous, flat at base, tapering and filiform below the anther; anthers ellipsoid, the 2 outer cells somewhat the larger; appendage to connective short, setose. *Ovary* and *stylopodium* ovoid-conical, densely evenly cream pubescent, tapering into a short glabrous style. *Fruit pedicel* 2 mm long, short. *Fruit calyx* sparsely pubescent towards base; outer lobes to 9 by 3 cm, spatulate, obtuse, tapering to 8 mm broad above the c. 8 by 8 mm saccate thickened base; 2 shorter lobes to 6 by 0.8 cm, linear, subacute, similar at base. *Nut* to 12 by 12 mm, broadly ovoid, densely shortly cream tomentose, tapering to the 4 mm acute style remnant.

Distr. *Malesia*: Malaya (E. coast: S. Trengganu, Pahang, Johore), N.W. Borneo (Brunei, N.E. Sarawak), E. coast Sumatra (sterile collections)?

Ecol. Heath forest on white sand giant podsols of Quaternary marine and estuarine terraces, and sandstone cuestas to 800 m. Locally semi-gregarious.

Vern. *Balau pasir*, *b. laut*, *b. betul* (Mal.).



**19. *Shorea atrinervosa*** SYM. Gard. Bull. S. S. 10 (1939) 363, pl. 21; Mal. For. Rec. 16 (1943) 9, f. 5A, 6; BROWNE, For. Trees Sarawak & Brunei (1955) 167; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 163, f. 17, pl. 12b; ASHTON, Man. Dipt. Brun. Suppl. (1968) 68, f. 9. — *S. collina* (non RIDL.) FOXW. Mal. For. Rec. 10 (1932) 173, p.p. — *S. ? inappendiculata* (non BURCK) SYM. ex DESCH, Mal. For. Rec. 12 (1936) 9, p.p.; Govt. Gaz. F.M.S. 29, 26 by 3.5–9 cm, elliptic to ovate, p.p. — **Fig. 78 A–A3.**

Large tree. Bud, twig and petiole at first caducous buff pubescent, outside of stipule persistently sparsely so, vegetative parts otherwise glabrous. *Twig* c. 2 mm  $\varnothing$  apically, terete, drying ribbed; stipule scars short, pale horizontal. *Bud* to 4 by 2 mm, narrowly ovoid, acute. *Stipule* to 8 by 3 mm, lanceolate, acute, caducous. *Leaves* 8–16 by 3.5–9 cm, elliptic to ovate, frequently irregular in shape, coriaceous, undulate,  $\pm$  persistently white lepidote beneath; base broadly cuneate to subcordate; acumen to 1 cm long; nerves 10–12 pairs, prominent beneath, glabrous, frequently somewhat sinuous, at 45°–55° except at base, sometimes with small glabrous axillary domatia; tertiary nerves sinuous, slender, scalariform; midrib raised above, prominently so beneath; *petiole* 12–22 mm long, terete. *Panicle* to 11 cm long, terminal or axillary, straight, terete, densely somewhat unevenly shortly pale grey pubescent; singly branched, branchlets to 2 cm long, bearing to 6 secund flowers; *bracteoles* to 3 by 2 mm, elliptic, acute, sparsely pubescent, caducous. *Flower bud* to 8 by 3 mm, fusiform. *Calyx* shortly pubescent on parts exposed in bud; lobes ovate, acute, the inner 2 somewhat shorter, thinner, than the outer 3; *petals* crimson at centre, cream at margins, linear, sericeous on both surfaces. *Stamens* 25–33; filaments compressed at base, tapering, sparsely setose; anthers oblong-elliptic, glabrous, the inner pair of pollen sacs shorter, setose. *Ovary* and *stylopodium* ovoid, pubescent, surmounted by a short glabrous style. *Fruit pedicel* to 4 by 2 mm, broadening into calyx. *Fruit calyx* sparsely pubescent, tomentum caducous except at base; 3 longer lobes to 11 by 2.5 cm, spatulate, obtuse, c. 1 mm broad above the to 10 by 8 mm ovate thickened prominently saccate base; 2 shorter lobes to 8.5 by 0.9 cm, lorate, acute, similar at base. *Nut* to 2 by 1.3 cm, ovoid, densely shortly evenly buff pubescent; stylopodium to 2 mm long, short, conical.

Distr. *Malesia*: Malaya (E. coast: Trengganu to Johore), Sumatra (Atjeh, West coast south to Bangkahulu, Tapanuli; Riouw Distr. and Langkat in E.), northern Borneo (Ulu Kapuas, Sarawak, Sabah, Bulungan to W. Kutei).

Ecol. Undulating land in valleys, and on hillsides on clay rich soil, in Mixed Dipterocarp forest; locally common.

Vern. *Balau hitam* (Mal.), *rèsak bamban*, *rèsak bunga*, *laru bétina*, *mèranti hursik*, *rihir minyak kuyung* (Sumatra), *lèmbasung* (Tarakan), *mèlapi bukit* (Kapuas), *sèlangan batu hitam* (Sabah).

**20. *Shorea crassa*** ASHTON, Gard. Bull. Sing. 20 (1963) 271; Man. Dipt. Brun. (1964) 130, f. 13; *ibid.* Suppl. (1968) 69, pl. 13 (bark).

Medium-sized to large tree. Twig, panicle, bud, stipule (outside only; glabrescent within) and petiole densely shortly tomentose, with minute adpressed persistent hair tufts; leaf nervation beneath sparsely so. *Twig* to 5 by 2.5 mm  $\varnothing$  apically, compressed, becoming terete and glabrous, sometimes narrowly evenly cracked; stipule scars c. 2 mm long, cuneate, pale, ascending. *Bud* to 6 mm long and broad, ovoid, compressed, subacute. *Stipule* to 8 by 4 mm, ovate, cupped, subacute, fugaceous. *Leaves* 10–18 by 5–10 cm, elliptic to ovate, pale cream to golden lepidote beneath; base equal or subequal, cuneate or narrowly obtuse, occasionally subcordate; acumen to 1 cm long; nerves 7–11 pairs, prominent, well spaced, at c. 40°–55°; tertiary nerves slender, sinuate, densely scalariform; midrib applanate at base, depressed towards apex, above; *petiole* 3.5–5 cm long, stout. *Panicle* to 13 cm long, terminal or axillary, terete or somewhat compressed, ribbed on drying, stout; regularly singly branched, branchlets to 4.5 cm long, bearing to 12 distichous flowers; *bracteoles* to 3 mm long, suborbicular, shortly pubescent, caducous. *Flower bud* to 15 by 3.5 mm, narrowly lanceolate. *Calyx* pubescent outside, glabrescent within; lobes broadly ovate, subacute; outer lobes slightly longer, more obtuse than inner. *Petals* cream, pink at base, linear, shortly pubescent, glabrescent within. *Stamens* 38–46; filaments broad at base; tapering, hispid; anthers narrowly oblong, cells tapering, sacs subequal or the outer slightly larger; appendage to connective prominent but always shorter than the anther, setose. *Ovary* ovoid, glabrous at base, otherwise tomentose; stylopodium longer than ovary, cylindrical, tomentose; style very short, glabrous. *Fruit calyx* sparsely puberulent towards apex, more densely so towards base; 3 longer lobes to 9 by 2.5 cm, broadly spatulate, coriaceous, obtuse, c. 8 mm broad above the c. 1.5 by 1.3 cm elliptic shallowly saccate thickened base; 2 shorter lobes to 7 by 0.7 cm, narrowly oblong, similar at base. *Nut* to 2.5 by 2 cm, ellipsoid, densely shortly cream tomentose; style remnant stout, tapering, to 8 mm.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Ulu Kapuas, ? Puruktjau, sterile collections).

Ecol. Common on deep leached yellow sandy and sometimes clay soils, on low hills, terraces and occasionally dry sandstone ridges to 1000 m; mainly near the coast.

Vern. *Sèlangan batu daun tèbal* (Brun.).

**21. *Shorea obscura*** MEIJER, Act. Bot. Neerl. 12 (1963) 333, pl. 6; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 184, pl. 16 (bark); ASHTON, Man. Dipt. Brun. (1964) 142, f. 13; *ibid.* Suppl. (1968) 74.

Large tree. Leaf nervation beneath, petiole, twig, panicle, bud and stipule shortly evenly pale brown pubescent, almost entirely caducous except on panicle, bud and stipule. *Twig* c. 1.5–2 mm  $\varnothing$  apically, terete, slender, becoming glabrous; stipule scars short,

pale, obscure. *Bud* 2–4 by 1.5–2.5 mm, ovoid to falcate. *Stipule* to 7 by 2.5 mm, oblong, acute, caducous. *Leaves* 7–12 by 2.5–5 cm, ovate-lanceolate, coriaceous, cream lepidote beneath in mature trees, base cuneate; acumen to 1 cm long, narrow; with or without small pore-like axillary domatia; nerves 7–9 pairs, curved, rather prominent, at 30°–45°, tertiary nerves slender, scalariform at 90°; midrib appanate or slightly raised above; *petiole* 1.2–2 cm long, slender. *Panicle* to 12 cm long, terminal or axillary,  $\pm$  terete; singly branched, branchlets to 1.5 cm long bearing to 5 second flowers; *bracteoles* to 3 mm long, ovate-elliptic, acute, puberulent, fugaceous. *Flower bud* to 6 by 2 mm, lanceolate. *Calyx* shortly pubescent outside, glabrous within; lobes ovate, acute, the inner 2 somewhat thinner than the outer 3. *Petals* bright pink, cream at margin, linear, pubescent outside, puberulent within. *Stamens* 35–45; filaments compressed at base, tapering, glabrous; anthers oblong-elliptic, the inner sacs shorter than the outer; appendage to connective almost as long as anther, stout, setose. *Ovary* and *stylopodium* ovoid, pubescent but for the glabrous base, tapering into the short glabrous style. *Fruit calyx* shortly sparsely caducously cream pubescent; 3 longer lobes to 10 by 2 cm, spatulate, obtuse, to 5 mm broad above the *c.* 7 mm broad saccate base; 2 shorter lobes to 5 by 0.5 cm, subacute, narrowly oblong, similar at base. *Nut* to 12 by 9 mm, globose to ellipsoid, shortly buff pubescent, abruptly apiculate.

Distr. *Malesia*: Borneo (Sarawak N.E. of Rejang valley, Sabah, S.E. Borneo to Sampit).

Ecol. Local, skeletal shale soils on ridges and steep hillsides, typically at 600–800 m, but rarely below and to 1400 m.

Vern. *Mēlapi bukit* (Kapas), *buntok, bēnuas* (S.E. Borneo), *sēlangan batu tandok* (Sabah), *s.b. padi* (Brun.).

**22. *Shorea lunduensis*** ASHTON, Gard. Bull. Sing. 22 (1967) 284, pl. 29; Man. Dipt. Brun. Suppl. (1968) 73.

Large tree. Twigs and buds shortly evenly fugaceous buff pubescent; leaves glabrous. *Twig c.* 3 by 2 mm  $\varnothing$  apically, at first compressed, somewhat lustrous; stipule scars *c.* 3 mm long, pale, prominent, ascending. *Bud* to 5 by 3 mm, ovoid, acute. *Stipules* unknown. *Leaves* 14–24 by 6–15 cm, large,  $\pm$  broadly ovate to elliptic; base broadly cuneate to subcordate; acumen to 1 cm long; nerves 11–15 pairs, obscure above, prominent beneath, at 40°–55° to the midrib; tertiary nerves sinuate, densely scalariform; midrib hardly elevated above, prominent beneath; *petiole* 2–3.5 cm long, stout. *Panicle* to 12 cm long, terminal or axillary, subterete, densely shortly tufted buff pubescent, singly or doubly branched, branchlets to 3 cm long; *bracteoles* to 4 by 2 mm, ovate, densely shortly pubescent, fugaceous. *Flowers* second; *bud* to 10 by 3 mm, narrowly ovoid, with the calyx somewhat spreading. *Calyx* sericeous in parts exposed in bud; sepals narrowly ovate, subacute, the inner 2 smaller, relatively broader, than the outer 3. *Petals* cream, linear, densely pubescent on parts exposed in bud.

*Stamens* 47–52; filaments compressed, tapering, glabrous; anthers oblong, tapering distally, glabrous; appendage to connective exceeding length of anther, densely setose. *Ovary* and *stylopodium* pyriform, densely pubescent, crowned by a glabrous columnar style. *Mature fruit* unknown; sparsely shortly pubescent at first. *Calyx lobes* unequal, 3 long and two short, spatulate, subacute. *Nut* crowned by a short, *c.* 1 mm long, apiculus.

Distr. *Malesia*: Borneo (W. Sarawak).

Ecol. Local, lower slopes of granodiorite mountains to 650 m, and along porphyry dikes in sedimentary areas.

Note. Possibly vicarious with *S. collina* of E. coastal Malaya.

**23. *Shorea falciferoides*** FOXW. Philip. J. Sc. 13 (1918) Bot. 189; *ibid.* 67 (1938) 296; ASHTON, Gard. Bull. Sing. 31 (1978) 37, incl. *ssp. glaucescens* (MEIJER) ASHTON. — *S. balangeran* (non BURCK) VIDAL, Phan. Cuming. (1885) 97; Rev. Pl. Vasc. Filip. (1886) 61; BRANDIS, J. Linn. Soc. Bot. 31 (1885) 86; FOXW. Philip. J. Sc. 4 (1909) Bot. 508, 516; *ibid.* 6 (1911) Bot. 269; WHITFORD, Bull. For. Bur. Philip. 10 (1911) 73; FOXW. Philip. J. Sc. 13 (1918) Bot. 187; MERR. En. Philip. 3 (1923) 96; REYES, Philip. J. Sc. 22 (1923) 336; SYM. Gard. Bull. S. S. 8 (1935) 273; ASHTON, Gard. Bull. Sing. 31 (1978) 36. — *S. gisok* FOXW. Philip. J. Sc. 67 (1938) 294, pl. 4 — **Fig. 77.**

**a. *ssp. falciferoides*.**

Large tree. Young twig, panicle, petiole, leaf bud and stipule shortly densely evenly cream pubescent. *Twig c.* 2–3.5 mm  $\varnothing$  apically, terete or  $\pm$  compressed and ribbed, stout, smooth; stipule scars *c.* 1.5 mm long, pale, cuneate, horizontal. *Bud* to 5 by 3.5 mm, globose to ovoid, subacute, slightly compressed. *Stipules c.* 10 by 4 mm, obtuse, fugaceous. *Leaves* 10–18 by 4.5–8 cm, broadly ovate, chartaceous, pale cream-brown lepidote beneath; base obtuse to cuneate, subequal; acumen to *c.* 8 mm long; nerves 8–11 pairs, slender, well spaced, raised but not prominent beneath, at *c.* 40°–50°; tertiary nerves slender, densely scalariform, at *c.* 90° to the nerves; *petiole* 1.5–2 cm long, stout. *Panicle* to 4 cm long, terminal or axillary, ribbed and somewhat compressed; singly branched, branchlets to 1.2 cm long, bearing to 6 close second flowers; *bracteoles* to 3 mm long, elliptic, shortly pubescent, fugaceous. *Flower bud* to 5 by 2.5 mm, small, lanceolate. *Calyx* densely pubescent outside, glabrous within; lobes suborbicular, obtuse, subequal. *Petals* cream, narrowly elliptic, acute, shortly pubescent on both surfaces. *Stamens c.* 45; filaments glabrous, appanate at base, tapering and filiform distally, somewhat gibbous; anthers subglobose, the 2 outer cells slightly larger; appendage to connective very short on inner anthers,  $\pm \frac{1}{2}$  length of anthers on outer anthers, sparsely shortly setose but for a single long apical bristle. *Ovary* and *stylopodium* ovoid, densely pubescent, tapering into the short glabrous style. *Fruit calyx* sparsely puberu-



lent, more densely so at the base; 3 longer lobes to 9.5 by 2.2 cm, broadly spatulate, obtuse, with c. 8 by 8 mm thickened saccate base closely adpressed to the base of the nut; 2 shorter lobes to 7 by 1 cm, subequal, broad, tapering to 5 mm broad above the saccate base. *Nut* c. 15 by 15 mm, broadly ovoid, shortly densely cream-buff tomentose; style remnant c. 4 mm long, tapering.

Distr. *Malesia*: throughout the Philippine islands to Prov. Zambales and Bulacan (Central Luzon) in the moderately seasonal northwest.

Ecol. In Mixed Dipterocarp forest to 1000 m, more or less confined to ridge tops in the everwet areas.

Note. Specimens from the more seasonal N.E. Luzon (*S. falciferoides*) have more or less smaller leaves than other Philippine collections (formerly named *S. gisok*).

**b. ssp. *glaucescens* (MEIJER) ASHTON**, Gard. Bull. Sing. 31 (1978) 37. — *S. glaucescens* MEIJER, Act. Bot. Neerl. 12 (1963) 327, pl. 3; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 170; ASHTON, Man. Dipt. Brun. (1964) 134, f. 13; *ibid.* Suppl. (1968) 71.

Leaves broadly ovate-falcate, chartaceous, base subequal; nerves 8–12 pairs, well spaced, raised but not prominent beneath; petiole rather stout.

Distr. *Malesia*: Borneo, except the west and southwest.

Ecol. Clay rich soils in Mixed Dipterocarp forest to 600 m.

Vern. *Sēlangan batu daun nipis* (Brun.), *s. b. laut* (Sabah).

Note. Differs from the type subspecies only in the leaf characters.

**24. *Shorea superba* SYM.** Gard. Bull. Sing. 17 (1960) 491; ASHTON, Man. Dipt. Brun. (1964) 146, f. 13; *ibid.* Suppl. (1968) 146; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 187, f. 22, pl. 18–19 (habit). — **Fig. 9.**

Vast, prominently buttressed tree. Twig, panicle, leaf bud, stipule, petiole and nerves beneath densely shortly evenly pink-brown pubescent. *Twig* c. 2.5 by 1 mm  $\varnothing$  apically, compressed and ridged at first, becoming terete, much branched; stipule scars c. 1.5 mm long, pale, linear, horizontal. *Leaf bud* to 4 by 3 mm, ovoid, compressed, slightly asymmetrical, subacute. *Stipule* to 12 by 5 mm, ovate-lanceolate, fugaceous. *Leaves* 7–12 by 4–7 cm, oblong, thinly coriaceous, silver to cream lepidote beneath; base broadly cuneate; acumen 5–10 mm long, broad; nerves 16–24 pairs, dense, straight, at 50°–60°; midrib slender, prominent beneath, depressed above; tertiary nerves densely scalariform, slender,  $\pm$  obscure; *petioles* 1–1.5 cm long, slender. *Panicle* to 8 cm long, terminal or axillary, somewhat compressed and ribbed; regularly singly branched, branchlets to 2 cm long, bearing to 8 close secund flowers; *bracteoles* to 5 mm long, lanceolate, acute, caducous. *Flower bud* to 7 by 2 mm, lanceolate. *Calyx* shortly pubescent outside, glabrous within; 3 outer lobes deltoid-ovate, acute; 2 inner lobes smaller, ovate, acuminate, thinner. *Petals* cream, linear, shortly tomentose outside, glabrous

within, hardly contorted. *Stamens* c. 30, subequal; filaments compressed and broad at base, tapering; anthers oblong, the outer sacs larger than the inner, glabrous; appendage to connective short, setose. *Ovary* and *stylopodium* cylindrical to conical, tomentose; style short, glabrous. *Fruit calyx* puberulent; 3 longer lobes to 6 by 1.2 cm, spatulate, acute or obtuse, tapering to a c. 8 by 8 mm elliptic saccate thinly incrassate base; 2 shorter lobes to 30 by 4 mm linear, acute, similar at base. *Nut* to 12 by 7 mm, ovoid, shortly pubescent; style remnant short.

Distr. *Malesia*: Borneo (Sarawak N.E. of Bintulu, Sabah, Tidung, Berau, Sampit; sterile coll.).

Ecol. Fertile clay soils at low altitudes in Mixed Dipterocarp forest to 600 m.

Vern. *Sēlangan batu daun halus* (Sabah), *s.b. tulang ikan* (Brun.).

**25. *Shorea hypoleuca* MEIJER**, Act. Bot. Neerl. 12 (1963) 329, pl. 4; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 174, pl. 13; ASHTON, Man. Dipt. Brun. Suppl. (1968) 72, f. 9. — **Fig. 78 D–D3.**

Large tree. Midrib above, bud and stipule outside shortly evenly persistently ocherous pubescent, twig caducously so; twig, midrib above, petiole and leaf beneath yellowish lepidote. *Twig* 1.5–2 mm  $\varnothing$  apically, ribbed, becoming terete, smooth; stipule scars short, falcate, descending. *Stipule* to 7 by 4 mm, oblong-ovate, subacute, fugaceous. *Leaves* 8.5–17 by 3.5–8 cm, ovate to narrowly elliptic, coriaceous, yellowish lepidote beneath; margin undulate distally; base cuneate to obtuse; acumen to 1.5 cm long, slender; nerves 11–16 pairs, prominent beneath, straight, oblique at 30°–50°, with small subglabrous axillary domatia; tertiary nerves slender, scalariform; midrib depressed above, prominent beneath; *petiole* 10–16 mm long, rather short, terete. *Panicle* to 14 cm long, terminal or axillary, ribbed, shortly sparsely puberulent; singly branched, branchlets to 2.5 cm long, bearing to 5 secund flowers; *bracteoles* fugaceous. *Flower buds* to 10 by 2 mm, fusiform. *Calyx* pubescent on parts exposed in bud; lobes ovate; inner 2 subacuminate, smaller than outer 3; outer 3 subacute. *Petals* pale yellow, linear, pubescent on parts exposed in bud. *Stamens* c. 33; filaments glabrous, broad and compressed at base, tapering abruptly and filiform distally; anthers elliptic-oblong, glabrous; appendage to connective as long as anther, setose, the apical bristles longer and exceeding length of anther; *ovary* and *stylopodium* pyriform, densely pubescent, crowned by a short glabrous filiform style. *Fruit calyx lobes* sparsely puberulent basally, glabrous distally; 3 longer lobes to 8.5 by 1.7 cm, narrowly spatulate, obtuse, to c. 3 mm broad above the to 10 by 6 mm narrowly elliptic thickened saccate base; 2 shorter lobes to 6 by 0.4 cm, subacute, similar at base. *Nut* to 15 by 10 mm, ovoid, densely evenly pale buff pubescent; *stylopodium* to 3 mm long, slender.

Distr. *Malesia*: Northern Borneo (Sarawak, Sabah, Tidung).

Ecol. Alluvium, undulating land, hillsides below

300 m, on fertile deep soils in Mixed Dipterocarp forest.

Vern. *Sēlangan batu kēlabu*.

**26. *Shorea malibato*** Foxw. in Elmer, Leaflet. Philip. Bot. 6 (1913) 1955; Philip. J. Sc. 13 (1918) Bot. 189, pl. 6; *ibid.* 67 (1938) 298; MERR. En. Philip. 3 (1923) 97; SLOOT. in Merr. Pl. Elm. Born. (1929) 203.

Large buttressed tree. Buds, twigs and parts of perianth exposed in bud caducously pale cream puberulent, petioles more persistently so; panicles and ovary persistently so. *Twigs* c. 1 mm  $\varnothing$  apically, much branched, terete, becoming smooth to rugulose, blackish. *Buds* to 4 by 2 mm, lanceolate-falcate, acute. *Stipules* fugaceous, not seen. *Leaves* 7–12 by 2–5 cm, elliptic to lanceolate,  $\pm$  thinly coriaceous; base broadly cuneate; acumen to 1.5 cm long, tapering, slender; nerves 11–14 pairs, slender but distinctly elevated beneath, distinctly depressed above except in young trees, at 35°–50°; tertiary nerves densely scalariform, obscure; midrib prominent beneath, obscure and depressed above; *petiole* 9–20 mm long, very slender. *Panicles* to 8 cm long, slender, terminal or axillary, pendant, singly or doubly branched. *Flower bud* to 5 by 3 mm; sepals broadly ovate, acute. *Stamens* 35–37; filaments glabrous; anthers ellipsoid; appendages prominent, with 1–3 long terminal, and 2–3 shorter lateral setae. *Ovary* ovoid-conical, style short. *Mature fruit* unknown. *Fruit* subsessile; *calyx lobes* unequal, 3 longer lobes c. 5 by 1.3 cm, spatulate, obtuse, c. 3 mm broad above the c. 5 by 4 mm elliptic saccate thickened base; 2 shorter lobes c. 25 by 3 mm, linear, similar at base; *nut* small, ovoid, apiculate.

Distr. *Malesia*: Philippines (Mindanao, Leyte and Luzon).

Ecol. Local in non-seasonal evergreen forests of lowlands.

Vern. *Malibato*, *yakal* (Tayabas, Zamboanga), *guisok*, *g. amarillo* (Camarines), *g. madlao* (Leyte).

Note. Replacing *S. hypoleuca* in the Philippines, from which it differs notably in the number of stamens and the smaller, less coriaceous leaf with narrowly channelled nerves above.

**27. *Shorea astylosa*** Foxw. Philip. J. Sc. 13 (1918) Bot. 188, pl. 5; *ibid.* 67 (1938) 297; MERR. En. Philip. 3 (1923) 96; ASHTON, Gard. Bull. Sing. 31 (1978) 37. — *S. ciliata* (non KING) Foxw. Philip. J. Sc. 13 (1918) Bot. 188; *ibid.* 67 (1938) 300.

Large tree. Young twigs and petioles caducous buff puberulent, panicles and buds persistently so, calyx thus at first, becoming sparsely so, parts of petals exposed in bud and ovary densely persistently cream pubescent. *Twigs* c. 1 mm  $\varnothing$  apically, slender, much branched, terete, smooth. *Buds* small, ovoid; *stipules* fugaceous, not seen. *Leaves* 6.5–12 by 2.5–6.5 cm, ovate, thinly coriaceous,  $\pm$  lustrous above, glabrous or  $\pm$  densely cream lepidote beneath the nerves excepted; base cuneate to obtuse, subequal; acumen to 1.5 cm long, slender, tapering; nerves 8–9 pairs, slender, somewhat elevated beneath, evident but  $\pm$

applanate above as also the midrib, arched and somewhat sinuate, set at 45°–75°, with  $\pm$  prominent glabrous pore-like domatia; tertiary nerves densely scalariform, obscure; *petiole* 11–25 mm long, long, slender, geniculate. *Panicle* to 9 cm long, terminal or axillary, singly branched; branchlets short, few-flowered. *Flower buds* to 5 by 3 mm, fusiform; *sepals* broadly ovate, acute, subequal; *stamens* 32, subequal; filaments compressed, tapering; anthers oblong, glabrous, the outer cells tuberculate at base; appendages exceeding anther apex, densely setose; *ovary* ovoid, tapering into a prominent stylopodium; style short, glabrous. *Fruit* (? immature): *Pedicle* c. 2 mm long, slender; 3 longer *calyx lobes* to 6 by 1.5 cm, spatulate, obtuse, c. 3 mm wide above the 7 by 4 mm ovate elliptic saccate thickened base; 2 shorter lobes to 25 by 2 mm, linear, similar at base; *nut* to 15 by 8 mm, ovoid, tapering into a long slender stylopodium.

Distr. *Malesia*: Philippines (Luzon, Biliran, Samar, Negros, Mindanao).

Ecol. Local, in Lowland Evergreen Dipterocarp forest.

Vern. *Yacal*.

Notes. This and the following species differ principally in the number of stamens as in the pair *S. seminis* and *S. sumatrana*, and like them occupy geographically separate ranges.

FOXWORTHY maintained that BS 18575 from Biliran I. and FB 22788 from Quezon Prov., Luzon represented a different taxon from the type of *S. astylosa* (FB 13271, from Zamboanga, Mindanao); he compared them with *S. ciliata* KING of Malaya. MERRILL was in disagreement and I concur with MERRILL that they belong to *S. astylosa*.

The species differs from the Bornean *S. domatiosa* ASHTON, with which it is vicarious, principally in having a prominent stylopodium and c. 32, in comparison with 25–30, stamens.

**28. *Shorea domatiosa*** ASHTON, Gard. Bull. Sing. 19 (1962) 285, pl. 16; Man. Dipt. Brun. (1964) 131, f. 13; *ibid.* Suppl. (1968) 69; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 166.

Large tree. Panicle, flowers and stipule outside pale cream pubescent, domatia fimbriate, parts otherwise  $\pm$  glabrous. *Twig* c. 1.5 mm  $\varnothing$ , much branched slender, terete, frequently wrinkled or compressed when dried, smooth; stipule scars short, pale, horizontal, obscure. *Bud* c. 4 by 2 mm, ovoid, acute. *Stipules* c. 6 by 2.5 mm, ovoid, narrowly obtuse, caducous. *Leaves* 6.5–10 by 3–7 cm, broadly ovate to obovate,  $\pm$  chartaceous, cream lepidote on undersurface only in fully mature and old tree; base obtuse or subcordate; acumen to 8 mm long; nerves 8–12 pairs, slender, curved, set at 45°–65°, with prominent axillary pore-like fimbriate domatia; tertiary nerves slender, densely scalariform, sinuate; midrib prominent beneath; *petiole* 1.5–2.5 cm long, slender, long, geniculate with the distal half swollen. *Panicle*, *bracts* and *bracteoles* unknown. *Bud* to 1.3 by 4 mm, fusiform. *Calyx* shortly pubescent outside, glabrous within; 3 outer



lobes broadly ovate, subacute, 2 inner lobes narrowly ovate, acute. *Petals* linear, obtuse, hardly contorted in bud, sparsely pubescent on parts exposed in bud, elsewhere glabrous. *Stamens* c. 25–30; filaments applanate towards base, tapering; anthers broadly oblong, the inner 2 pollen sacs shorter than the outer 2, with sparsely setose apices; appendage  $\frac{1}{2}$  as long as anther, stout, densely setose. *Ovary* ovoid, densely tomentose except at base; stylopodium  $1\frac{1}{2}$  times as long as ovary, very long, pubescent towards base, elsewhere glabrous. *Fruit calyx* glabrous; 3 longer

lobes to 13 by 3 cm, broadly spatulate, obtuse, to 8 mm broad above the to 1.8 by 1.6 cm elliptic saccate thickened base; 2 shorter lobes to 7 by 1.2 cm, narrowly spatulate, with similar base. *Nut* 8.5 by 2.5 cm, ovoid, densely shortly pale cream pubescent; style remnant to 1 cm long, filiform.

Distr. *Malesia*: N.E. Borneo (Rejang valley north-eastwards to S.W. and S.E. Sabah and Nunukan).

Ecol. Scattered on clay soils in Mixed Dipterocarp forest below 600 m.

Vern. *Selangau batu lobang idong*.

### 1b. Subsection *Barbata*

SYM. *ex* ASHTON, Gard. Bull. Sing. 20 (1963) 266; Man. Dipt. Brun. (1964) 166. — *Barbata* group SYM. J. Mal. Br. R. As. Soc. 79 (1941) 162. — **Fig. 82.**

Flower buds subglobose. Petals cream, short, elliptic-oblong, obtuse, connate at base on falling. Appendages and apices of outer anther cells densely setose.

Distr. Peninsular Burma and Thailand to *Malesia*: Sumatra, Borneo.

Ecol. Scattered in lowland forests below 1500 m.

**29. *Shorea glauca*** KING, J. R. As. Soc. Beng. 62, 2 (1893) 117; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 102; RIDL, Fl. Mal. Pen. 1 (1922) 223; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 300; *ibid.* ed. 2 (1927) 1118, 1121; FOXW. Mal. For. Rec. 3 (1927) 64; *ibid.* 10 (1932) 232; BURK. Dict. (1935) 2010; SYM. Mal. For. Rec. 16 (1943) 15, f. 6, 10.

Medium-sized or large tree. Parts of petals exposed in bud, ovary and panicles densely persistently evenly ocherous pubescent, sepals thus at first, becoming sparsely so in fruit; twigs, stipules outside, petiole, midrib above and leaves beneath persistently cream lepidote. *Twig* c. 1 mm  $\varnothing$  apically, terete, becoming smooth, pale brown. *Leaves* 6–15 by 2.3–9 cm, ovate to lanceolate, thin; margin undulate; base cuneate; acuminate to 2 cm long, slender, tapering, nerves 7–10 pairs, slender, hardly raised beneath, arched, at 50°–70° to the midrib; secondary nerves slender, scalariform, obscure; midrib applanate above, slightly elevated beneath; *petiole* 10–20 mm long, slender, terete. *Panicles* to 7 cm long, slender, lax, terminal or axillary, terete or compressed; singly or doubly branched, branchlets bearing to 8 secund flowers; *bracteoles* short, linear, fugaceous. *Flower bud* to 3 by 3 mm, globose; *sepals* broadly ovate, the 3 outer somewhat larger, acute, the inner 2 subacuminate; *stamens* c. 60, subequal; filaments broadly compressed at base, tapering; anthers lorate-oblong, barbate at base and apex, appendages not exceeding anthers, very short, villous; *ovary* ovoid, style short, broadly cylindrical. *Fruit pedicel* to 1 by 1 mm. 3 outer calyx lobes to 7 by 1.8 cm, spatulate, obtuse, c. 5 mm wide above the to 6 by 5 mm ovate, saccate thickened base; 2 shorter lobes to 5 by 1 cm, otherwise similar. *Nut* to 1.5 by 1.5 cm, broadly ovoid, shortly apiculate.

Distr. Peninsular Thailand, and in *Malesia*: Malaya, west coast Sumatra (from Painan to Atjeh), Simalur I.

Ecol. Local, but often semi-gregarious, on hills, especially rocky slopes and ridges, generally near the coast, to 600 m.

Vern. *Damar laut daun bĕsar, rĕsak, r. rĕmenia, terbak, sĕlimbar, damar laut kuning, tĕngkawang*.

Note. Flowering specimens, without which the species cannot always be distinguished with certainty from *S. materialis* and *S. falcifera* in subsect. *Shorea*, are unknown from east coastal Malaya, east coastal Sumatra and Riouw, and it seems unlikely that it occurs there in spite of earlier reports (e.g. SYMINGTON).

**30. *Shorea laevis*** RIDL, Fl. Mal. Pen. 1 (1922) 232; HEYNE, Nutt. Pl. ed. 2 (1927) 1121; FOXW. Mal. For. Rec. 10 (1932) 179; SYM. Mal. For. Rec. 16 (1943) 18, f. 6, 12; BROWNE, For. Trees Sarawak & Brunei (1955) 169; ASHTON, Man. Dipt. Brun. (1964) 139, f. 13, pl. 33 (habit), 35 (stem-base); *ibid.* Suppl. (1968) 73, f. 9; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 178, pl. 12a (habit), pl. 14a (stem), f. 20; ASHTON, Gard. Bull. Sing. 31 (1978) 38. — *S. ciliata* (non KING) RIDL, Agr. Bull. Str. & F.M.S. 4 (1905) 63; FOXW. Mal. For. Rec. 1 (1921) 69; *ibid.* 3 (1927) 66; *ibid.* 8 (1930) 19; EDWARDS, Mal. For. Rec. 9 (1931) 142. — *Hopea laevifolia* PARIJS in Fedde, Rep. 33 (1933) 244. — *S. laevifolia* ENDERT, Tectona 28 (1935) 292; BROWNE, For. Trees Sarawak & Brunei (1955) 171. — *S. rogersiana* RAIZADA & SMITINAND, Thai For. Bull. Bot. 1 (1954) 7.

Vast, prominently buttressed tree. All vegetative parts epilose. *Twig* c. 1 mm  $\varnothing$  apically, much branched, slender, terete, smooth; stipule scars small, obscure. *Bud* c. 3.5 by 1.5 mm, narrowly ovoid. *Stipule* to 8 by 2 mm, narrowly lanceolate, acute, fugaceous. *Leaves* 6.5–10 by 2.5–4 cm, narrowly ovate-lanceolate; falcate, thinly coriaceous, cream lepidote beneath in mature trees; base subequal, broadly

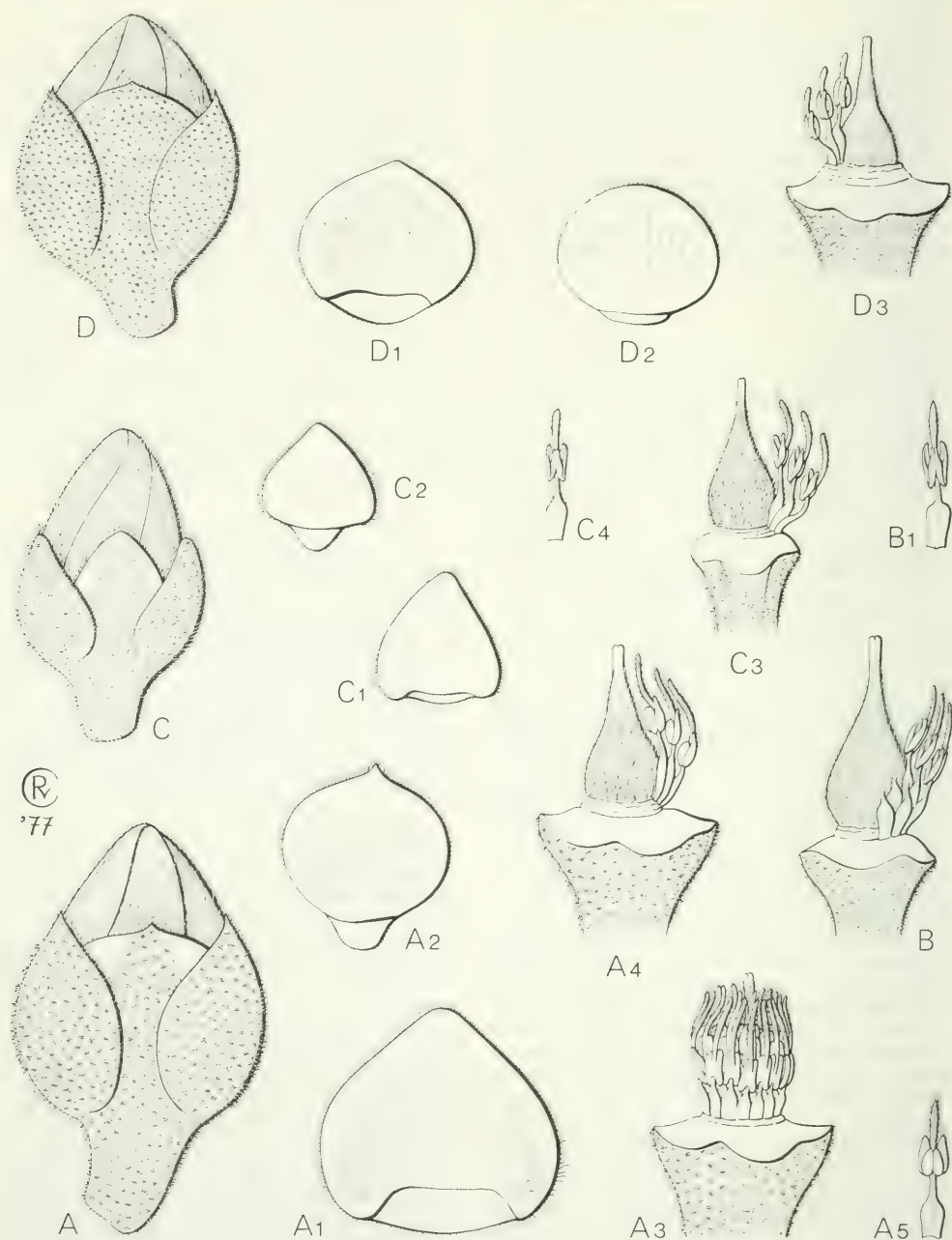


Fig. 82. Flower details in *Shorea* sect. *Shorea* subsect. *Barbata* SYM. ex ASHTON. All  $\times 10$ . Sepals drawn from inside. — *S. ladiana* ASHTON. A. Bud, A1. outer sepal, A2. inner sepal, A3. androecium, A4. three stamens and pistil, A5. stamen from inside. — *S. asahii* ASHTON. B. Stamens and pistil, B1. stamen from inside. — *S. maxwelliana* KING. C. Bud, C1. outer sepal, C2. inner sepal, C3. stamens and pistil, C4. stamen from inside. — *S. biawak* ASHTON. D. Bud, D1. outer sepal, D2. inner sepal, D3. stamens and pistil (A ROSLI 15025, B bb. 35219, C KEP 69917, D S 28778)



cuneate; acumen to 2 cm long, slender; nerves 11–14 pairs, slender, coriaceous, dense, curved, at c.  $50^{\circ}$ – $60^{\circ}$ , unraised on either surface as also the midrib; tertiary nerves slender, densely scalariform, diagonal to nerves; *petiole* 1–1.5 cm long, slender, geniculate. *Panicle* to 12 cm long, terminal or axillary, slender, terete, shortly persistently pale cream grey pubescent,  $\pm$  glabrescent; singly or doubly branched, branchlets to 3 cm long, bearing to 9 distichous flowers; *bracteoles* to 2 mm long, linear, pubescent, fugaceous. *Flower bud* to 2 mm long, globose. *Calyx* shortly pale cream-brown tomentose outside, glabrous within; 3 outer lobes ovate-deltoid, subacute; 2 inner lobes smaller, relatively broader, ovate, less acute. *Petals* elliptic-oblong, acute, shortly pubescent outside, puberulent within. *Stamens* c. 30; filaments broad at base, abruptly tapering, filiform and sparsely barbate distally; anther narrowly oblong, 2 outer sacs larger, sparsely barbate apically; appendage to connective up to 2 times length of anther, stout, barbate towards apex. *Ovary* and *stylopodium* ovoid, densely pubescent, tapering into the short slender glabrous style. *Fruit calyx lobes* to 4 by 4 mm, subequal, ovate, subacute, sparsely buff pubescent, adpressed to nut. *Nut* to 11 by 6 mm, oblong-ovoid, acute, densely buff pubescent.

Distr. Peninsular Burma and Thailand (Pattani); in *Malesia*: Malaya, N. Sumatra (Atjeh), Borneo.

Ecol. Widespread, often common and even gregarious on skeletal or dry soils on ridges in Hill Dipterocarp forest, typically at 200–1000 m, but sometimes lower.

Vern. *Kumas*, *k. mērah*, *k. hitam*, *sēlimbar*, *damar laut kuning* (Mal.), *mikai* (Sar.), *sēlangan batu kumus* (Sabah), *pēnyau* (W. Borneo), *bangkirai tanduk*, *b. lampong*, *mērenting*, *tēnggelan mēnpelam*, *gēlam* (S.E. Borneo), *bēnuas*, *b. layang* (S. Borneo).

**31. *Shorea asahii*** ASHTON, Gard. Bull. Sing. 19 (1962) 279, pl. 13; Man. Dipt. Brun. (1964) 128, f. 13; *ibid.* Suppl. (1968) 68; MELIER & WOOD, Sabah For. Rec. 5 (1964) 163. — **Fig. 82 B–B1.**

Medium-sized tree. Young parts at first shortly pubescent, otherwise glabrous but for panicles and flowers. *Twig* c. 0.7 mm  $\varnothing$  apically, slender, terete; stipule scars small, horizontal, obscure. *Bud* c. 1.5 by 1.0 mm, falcate, small. *Stipule* to 5 mm long, narrowly deltoid, fugaceous. *Leaves* 6–10 by 3–5 cm, ovate, coriaceous, lustrous; base broadly cuneate, subequal; acumen c. 1 cm long, narrow; nerves 6–7 pairs, arched, slender, at c.  $60^{\circ}$ ; midrib unraised on either surface, indistinct; tertiary nerves scalariform, dense, very slender and obscure, at  $90^{\circ}$  to midrib or slightly ascending though at  $90^{\circ}$  to the nerves nearer the margin; *petiole* c. 1 cm long, slender. *Panicle* to 2 cm long, terminal or axillary, slender, terete, straight, densely shortly cream tomentose; singly branched, branchlets to 7 mm long, short, zig-zag, bearing to 4 close second flowers; *bracteoles* to 2 mm long,

elliptic, acute, puberulent, fugaceous. *Flower bud* to 2 mm long, globose. *Calyx* shortly pubescent outside, glabrous within; 3 outer lobes ovate-deltoid, subacute; 2 inner lobes smaller, relatively broader, ovate, less acute. *Petals* elliptic-oblong, acute, shortly pubescent outside, puberulent within. *Stamens* c. 30; filaments broad at base, abruptly tapering, filiform and sparsely barbate distally; anther narrowly oblong, 2 outer sacs larger, sparsely barbate apically; appendage to connective up to 2 times length of anther, stout, barbate towards apex. *Ovary* and *stylopodium* ovoid, densely pubescent, tapering into the short slender glabrous style. *Fruit calyx lobes* to 4 by 4 mm, subequal, ovate, subacute, sparsely buff pubescent, adpressed to nut. *Nut* to 11 by 6 mm, oblong-ovoid, acute, densely buff pubescent.

Distr. *Malesia*: N.W. Borneo (Kapas valley; Rejang valley to Brunei).

Ecol. Local, on shale spurs below 850 m in Mixed Dipterocarp forest.

Vern. *Tēkam padi* (Iban), *kumus bukit* (Mal.).

**32. *Shorea micans*** ASHTON, Gard. Bull. Sing. 31 (1978) 38.

Medium-sized tree. Panicles and nut densely greyish puberulent, fruit calyx sparsely so, other known parts glabrous. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched, smooth, terete. *Buds* minute; *stipules* not seen. *Leaves* 5–10 by 1.8–4.7 cm, ovate-lanceolate, thinly coriaceous, lustrous on both surfaces; margin narrowly subrevolute; base broadly cuneate,  $\pm$  unequal; apex to 1.3 cm caudate; nerves 7–8 pairs, very slender, slightly elevated beneath,  $\pm$  applanate above, at  $50^{\circ}$ – $55^{\circ}$ ; tertiary nerves obscure, scalariform; midrib slender, evident and slightly elevated on both surfaces; *petiole* 7–12 mm long, rather short, very slender. *Panicle* to 7 cm long, terminal or subterminal axillary, slender, shortly branched. *Flowers* unknown. *Fruit pedicel* c. 1 mm long, slender; 3 longer *calyx lobes* to 5 by 1.5 cm, spatulate, obtuse, c. 4 mm broad above the to 8 by 7 mm elliptic saccate thickened base; 2 shorter lobes to 25 by 4 mm, narrowly spatulate, acute, similar at base; *nut* to 19 by 7 mm including the prominent slender apiculus, ovoid.

Distr. *Malesia*: N.E. Borneo (once collected north of Sandakan).

Ecol. On ultrabasic rock in lowlands.

Note. Differing (in the absence of flowering collection) from *S. asahii* only in the fruit sepals.

**33. *Shorea ladiana*** ASHTON, Gard. Bull. Sing. 19 (1962) 295, pl. 21; Man. Dipt. Brun. (1964) 138, f. 13; *ibid.* Suppl. (1968) 73. — **Fig. 82 A–A5.**

Small to medium-sized tree. Young twig and petioles shortly puberulent, bud and panicle grey tomentose, vegetative parts otherwise glabrous. *Twig* 1.5–2 mm  $\varnothing$  apically, terete, much branched, smooth to rugulose; stipule scars small, slightly descending, obscure. *Bud* c. 1 by 0.5 mm, small, conical. *Stipule* unknown. *Leaves* 10–14 by 4.5–7.5 cm, coriaceous,

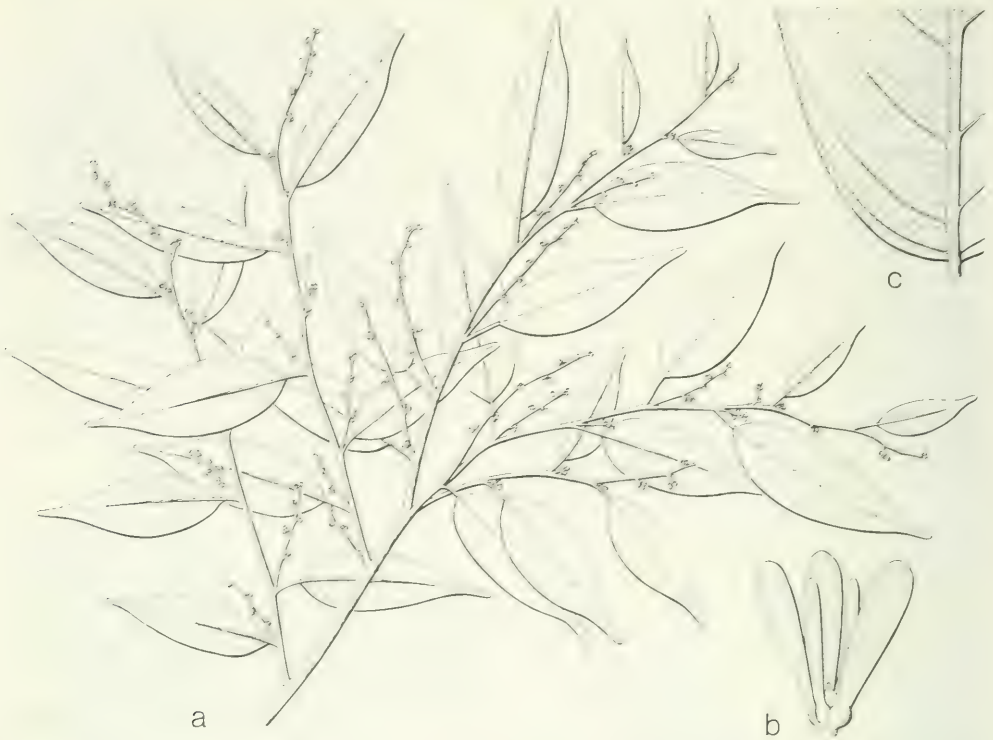


Fig. 83. *Shorea maxwelliana* KING. *a*. Habit. *b*. fruit, both  $\times \frac{1}{2}$ . *c*. venation, enlarged (*a* S 29235. *b*-*c* SAN 16988).

lustrous, ovate; base subequal to equal, obtuse or broadly cuneate; acumen 1-1.5 cm long; nerves 5-6 pairs, prominent beneath, well spaced, arched, set at *c.* 40°-50°; tertiary nerves slender, indistinct, densely scalariform, at 90°; margin usually narrowly revolute; *petiole* 1-2.2 cm long. *Panicle* to 15 cm long, terminal or to 2-axillary, somewhat compressed, straight, lax, shortly persistently pale cream-grey pubescent; singly or doubly branched; branchlets to 8 mm long, short, zigzag, bearing to 9 close secund flowers; *bracteoles* to 4.5 mm long, ovate-deltoid, acute, shortly pubescent, fugaceous. *Flower bud* to 1.5 mm  $\varnothing$ , globose (only young bud known). *Calyx* densely puberulent outside, glabrous within; *sepals* ovate, subequal. *Petals* broadly elliptic. *Stamens* 30-35; filaments short, tapering; anthers oblong, the outer sacs the larger, shortly barbate apically; appendage to connective longer than anther, long barbate. *Ovary* and *stylopodium* ovoid, densely pubescent, with short glabrous style. *Fruit pedicel* to 3 mm long, slender, puberulent. *Calyx* shorter than nut, the 5 equal lobes *c.* 8 mm long and broad, broadly ovate, puberulent, subacute, thickened, shallowly saccate, closely adpressed to the nut. *Nut* to 1.7 by 1.4 cm, obovoid-globose, densely

shortly buff pubescent, abruptly tapering to the *c.* 1 mm long narrow acute style remnant.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Ecol. Local, deep yellow sandy soils in Mixed Dipterocarp forest on low hills to 300 m.

Vern. *Sēlangan batu kilat*.

**34. *Shorea biawak* ASHTON**, Gard. Bull. Sing. 19 (1962) 281, pl. 14; Man. Dipt. Brun. (1964) 129, f. 13, pl. 37 (bark); *ibid.* Suppl. (1968) 68; MEIJER, & WOOD, Sabah For. Rec. 5 (1964) 165. — Fig. 82 D-D3.

Small tree. Young twig, panicle, leaf bud and petiole shortly pale buff pubescent, persistent on panicle and leaf bud. *Twig* to 1 mm  $\varnothing$  apically, slender, terete, much branched, smooth or striated. *Bud* to 1 mm long, small. *Stipule* unknown. *Leaves* 6-10 by 2.5-4.5 cm, obovate, thinly coriaceous; base obtuse or broadly cuneate; acumen to 1.5 cm long, narrow to caudate; nerves 5-6 pairs, slender, slightly raised beneath, slightly depressed above, arched, at 50°-60°, with small puberulent axillary domatia; tertiary nerves obscure, scalariform at *c.* 90°; midribs slightly raised beneath, slightly raised or appanate above; *petiole* 7-10 mm long, slender. *Panicle* to 14 cm



long, terminal or 1-axillary, terete; singly branched, branchlets to 6 mm long, short,  $\pm$  secund, bearing to 6 close secund flowers; *bracteoles* to 2 mm long, ovate, acute, puberulent, fugaceous. *Flower bud* to 1.5 mm long, globose. *Calyx* shortly puberulent outside, glabrous within; lobes broadly ovate, acute, subequal, the inner 2 slightly shorter and relatively wider, thinner. *Petals* elliptic, obtuse, puberulent outside, glabrous within. *Stamens* c. 35; filaments slender, tapering, glabrous; anthers narrowly oblong, sparsely barbate apically, tapering, the 2 outer sacs the larger; appendage to connective somewhat shorter than anther, densely barbate. *Ovary* and *stylopodium* ovoid to pyriform, densely pubescent, crowned by a short glabrous style. *Fruit calyx lobes* to 7 by 9 mm, subequal, shorter than nut, suborbicular, obtuse, thin, closely adpressed to nut, shortly persistently buff puberulent. *Nut* to 1.3 by 1 cm, subglobose, obtuse, densely pale buff pubescent; style remnant to 1.5 mm long.

Distr. *Malesia*: Borneo (Rejang valley to S. Sabah).

Ecol. Local, clay ridges below 600 m, in Mixed Dipterocarp forest.

Vern. *Resak biawak* (Brun.), *sēlangan batu buaya* (Mal.).

Note. Forming, with *S. maxwelliana*, a pair similar to *S. asahii* and *S. micans*, and differing from the following species principally in the fruit, though also in the androecium.

**35. *Shorea maxwelliana*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 114; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 86; RIDL, Fl. Mal. Pen. 1 (1922) 227; Foxw. Mal. For. Rec. 3 (1927) 35; *ibid.* 10 (1932) 194; SYM. Gard. Bull. S. S. 7 (1933) 146, pl. 44; *ibid.* 8 (1934) 28; *ibid.* 9 (1938) 325, 326; Mal. For. Rec. 16 (1943) 21, f. 5B, 6, 14; BROWNE, For. Trees Sarawak & Brunei (1955) 169; ASHTON, Man. Dipt. Brun. (1964) 141, f. 13, pl. 36 (bark); *ibid.* Suppl. (1968) 74; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 182, t. 15, f. 21. — *S. utilis* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 119; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 81; RIDL, Agr. Bull. Str. & F.M.S. 1 (1901) 58; Fl. Mal. Pen. 1 (1922) 230; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 310; *ibid.* ed. 2 (1927) 1126; Foxw. Mal. For. Rec. 3 (1927) 65; *ibid.* 10 (1932) 177; BURK, J. Str. Br. R. As. Soc. 81 (1920) 69, fig.; *ibid.* 86 (1922) 281. — *S. barbata* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 81; RIDL, Agr. Bull. Str. & F.M.S. 1 (1901) 59; J. Str. Br. As. Soc. 54 (1909) 23; Fl. Mal. Pen. 1 (1922) 230; Foxw. Mal. For. Rec. 1 (1921)

68; *ibid.* 3 (1927) 68; *ibid.* 10 (1932) 178. — *S. ciliata* (non KING) RIDL, Agr. Bull. Str. & F.M.S. 4 (1905) 63. — *S. alba* RIDL, J. Str. Br. R. As. Soc. 82 (1920) 171; Fl. Mal. Pen. 1 (1922) 230. — *Balanocarpus ovalifolius* RIDL, J. F.M.S. Mus. 10 (1920) 130, p.p.; Fl. Mal. Pen. 1 (1922) 247, p.p. — **Fig. 82 C–C4, 83.**

Tall, prominently buttressed tree. Vegetative parts glabrous but for the shortly pubescent to glabrescent buds and stipules. *Twig* c. 0.7 mm  $\varnothing$  apically, slender, much branched, smooth; stipule scars minute, short, obscure. *Bud* c. 1 mm long and broad, minute, globose to conical. *Stipule* to 4 mm long, puberulent on both surfaces, linear, fugaceous. *Leaves* 6–10 by 2.5–4 cm, coriaceous, ovate-lanceolate, sometimes sparsely cream lepidote beneath; base obtuse or broadly cuneate; apex to 2 cm long caudate; nerves 8–10 pairs, slender; midrib elevated beneath, depressed above, at c. 40°–50°, well spaced, curved, with or without minute axillary domatia; tertiary nerves very slender, scalariform, at 90°; *petiole* 0.7–1 cm long, slender. *Panicle* to 5 cm long, terminal or to 3-axillary, terete, straight, shortly evenly buff pubescent; singly branched, branchlets to 1.3 cm long, short, bearing to 6 close secund flowers; *bracteoles* to 1.5 mm long, elliptic, puberulent, fugaceous. *Flower bud* to 2.5 mm long, globose. *Calyx* shortly pubescent outside, glabrous within. *Stamens* c. 30; filaments broad at base, tapering gradually to anther, glabrous; anther narrowly oblong, outer cells larger, barbate apically; appendage to connective as long as anther, barbate at apex. *Ovary* and *stylopodium* ovoid to pyriform, densely pubescent; style glabrous, short. *Fruit calyx*  $\pm$  puberulent, more densely so towards base; 3 longer lobes to 10 by 1.5 cm, spatulate, obtuse, to 4 mm broad above the to 1.5 by 1 cm elliptic somewhat thickened prominently saccate base; 3 shorter lobes to 6 by 0.6 cm, otherwise similar. *Nut* to 2 by 1.5 cm, ovoid, tapering, apiculate, densely buff pubescent.

Distr. *Malesia*: Malaya (Penang and Trengganu southwards), Sumatra (Atjeh, West Coast, Lampong), Borneo.

Ecol. Widespread, sometimes common, in Mixed Dipterocarp forest in low hills on well drained clay-rich soils to 700 m.

Vern. *Damar laut daun kēchil, kumus hitam, chēnderas, chēngal batu, resak, r. hitam, balau, sēngkawang, damar laut kuning* (Mal.), *sēlangan batu asam* (Sabah), *pakit* (W. Borneo), *tēkam tēgelam* (Iban, Tidung), *rikir, r. minyak, r. sēga, damar bintang, resak tanduk* (Sumatra).

## 2. Section *Pentacme*

(DC.) ASHTON, Gard. Bull. Sing. 31 (1978) 38. — *Pentacme* A. DC. Prod. 16, 2 (1868) 626; KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 151; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 72; Foxw. Mal. For. Rec. 10 (1932) 154; SYM. Mal. For. Rec. 16 (1943) 104, f. 63 (map), 64–66. — **Fig. 84.**

*Flowers* large, cream, ovoid, on lax spreading racemes. *Petals* broadly elliptic, ovate, hardly contorted, falling separately. *Stamens* 15, in 3 verticils; filaments short, applanate, tapering; anthers linear, glabrous, with 4 pollen sacs each prolonged and tapering apically into a prominent awn at least as long as the stoutly acicular  $\pm$  recurved appendage. *Ovary* ovoid, style filiform. *Stipules* and *bracts* fugaceous, small. *Leaf* with scalariform tertiary nerves; midrib raised, evident, above. *Bark surface* V-section fissured. Wood anatomy and properties widely divergent between S.E. Asia and Philippine species.

Distr. One species in seasonal S.E. Asia and *Malesia*: Malaya, and one in the Philippines.

Ecol. See under the species.

Note. *S. siamensis* differs from the Philippine species in having a hard heavy durable wood anatomically similar to that in *sect. Shorea*; in the Philippine species the wood is soft, light and unsuitable for exterior work.

**36. *Shorea siamensis*** MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 214; DC. Prod. 16, 2 (1868) 631; WALP. Ann. 7 (1868) 379; DYER, Fl. Br. Ind. 1 (1874) 304; RYAN & KERR, J. Siam Soc. 8 (1911) 7, 15, 35, t. 1-4; ASHTON, Gard. Bull. Sing. 31 (1978) 39. — *Hopea suava* WALL. [Cat. (1828) n. 959, *nomen*] ex A. DC. Prod. 16, 2 (1868) 635. — *Pentacme suavis* A. DC. Prod. 16, 2 (1868) 626; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 72; Indian Trees (1906) 68; GAMBLE, Man. Ind. Timb. (1922) 77; TROUP, Silv. Ind. Trees 1 (1921) 145; CRAIB, Fl. Siam. Enum. 1 (1925) 145; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 259; SMITINAND, Thai For. Bull. 1 (1954) 9, 10, 24. — *Pentacme siamensis* (MIQ.) KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 66; Fl. Burma 1 (1877) 119; PIERRE, For. Fl. Coch. 3 (1889) t. 225-227, incl. *var. laevis* PIERRE et *var. suavis* (DC.) PIERRE; HEIM, Rech. Dipt. (1892) 56; Bot. Tidsskr. 25 (1902) 46; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 263, fig.; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 379, 385, fig.; CRAIB, Fl. Siam. Enum. 1 (1925) 145; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 238; FOXW. Mal. For. Rec. 8 (1930) 15, 35; *ibid.* 10 (1932) 155, pl. 2 (seedlings); BURK. Dict. (1935) 1690; SYM. Mal. For. Rec. 16 (1943) 105, f. 64-66. — *S. bracteata* PIERRE ex LANESSAN, Pl. Util. Colon. Fr. (1886) 301. — *S. mekongensis* PIERRE ex LANESSAN, l.c. — *S. suavis* PIERRE ex LANESSAN, l.c. — *S. tomentosa* (non MIQ.) PIERRE, For. Fl. Coch. 3 (1889) sub t. 225 in *syn.* — *Pentacme malayana* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 107; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 151, t. 184; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 62; Fl. Mal. Pen. 1 (1922) 220; CRAIB, Fl. Siam. Enum. 1 (1925) 145. — *Pentacme tomentosa* CRAIB, Kew Bull. (1915) 423; Fl. Siam. Enum. 1 (1925) 145.

Small gnarled,  $\pm$  shortly deciduous tree (in *Malesia*). Young calyx, twigs and panicle caducous puberulent, otherwise glabrous (in *Mal.*). Twigs 3-5 mm  $\varnothing$  apically, terete, smooth; stipule scars short, pale. *Bud* small, ovoid, acute; stipule to 18 by 7 mm, ovate-falcate, fugaceous. *Leaves* 9-12 by 6-13 cm (smaller if subtending panicles), broadly ovate-oblong, chartaceous; base deeply cordate to cuneate (if subtending panicles); acuminate to 1 cm long, short, broad; nerves 13-16 pairs, slender but prominent beneath, barely elevated above as also the midrib, arched, the basal

pair with prominent lateral branchlets; tertiary nerves remotely scalariform, sinuate, slender but typically prominently elevated beneath; *petiole* 3-5 mm long, c. 2 mm  $\varnothing$ , straight. *Panicle* to 14 mm long, terminal or axillary, lax, peduncle stout at base; irregularly branched, branchlets to 7 cm long, bearing a few  $\pm$  secund flowers. Anthesis directly following leaf fall; *bud* to 15 by 6 mm, large, ellipsoid; *sepals* narrowly ovate, prominently slender, acuminate, subequal; *petals* broadly elliptic, glabrous (in *Mal.*); *stamens* 15, subequal; filaments loricate, slightly tapering; anther cells linear, extended apically beyond the connective into prominent tapering horns c.  $\frac{1}{2}$  their length; appendages acicular, glabrous, c.  $\frac{1}{2}$  length of anthers; *ovary* narrowly ovoid, tapering into a stoutly columnar style c. twice its length and exceeding the stamens at anthesis. *Fruit pedicel* to 5 by 3 mm, broadening into the receptacle; 3 longer *calyx lobes* to 12 by 1.3 cm, narrowly spatulate, narrowly obtuse, c. 4 mm broad above the to 8 by 7 mm elliptic saccate thickened base; 2 shorter lobes to 7 by 0.5 cm, loricate, subacute, similar at base. *Nut* to 20 by 12 mm, ovoid, tapering into an up to 8 mm long prominent acicular style remnant.

Distr. Burma, Indochina and Thailand south to *Malesia*: N.W. Malaya (Langkawi and once in Perlis).

Ecol. A tree of Dry Dipterocarp forests, especially on skeletal soils and overlying granite; occurring scattered on rocky headlands in Malaya.

Vern. *Tĕmak batu*, *tĕmak*, *mĕranti tĕmak*.

Note. Varying greatly in the distribution and density of the tomentum, reduction of which is roughly correlated with increasing humidity of climate or soil. The species *Pentacme malayana* (leaf glabrescent) and *P. tomentosa* (both surfaces of leaf tomentose) were distinguished from *P. siamensis* (= *suavis*) with tomentose leaf undersurface, but the continuous variation which exists in nature suggests merely ecotypic differentiation in panmictic populations.

**37. *Shorea contorta*** VIDAL, Sinopsis (1883) 15, t. 15E; Rev. Pl. Vasc. Filip. (1886) 61; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 88; MERR. Philip. J. Sc. 1 (1906) Suppl. 98; ASHTON, Gard. Bull. Sing. 31 (1978) 40. — *Pentacme contorta* (VIDAL) MERR. & ROLFE, Philip. J. Sc.



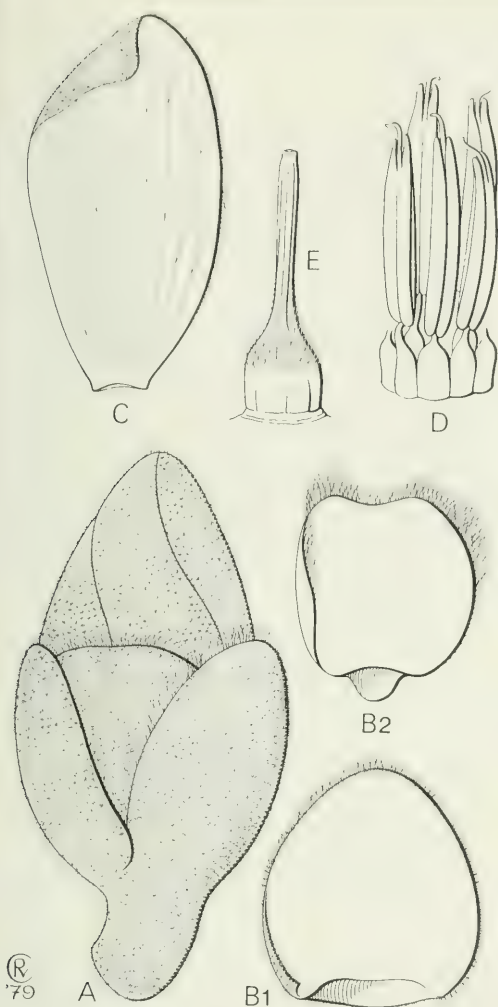


Fig. 84. Flower details in *Shorea* sect. *Pentacme* (DC.) ASHTON. — *S. contorta* VIDAL. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C. petal, D. stamens from outside, E. pistil, all  $\times 10$  (FB 10721).

3 (1908) Bot. 115; MERRITT, Bull. Bur. For. Philip. 8 (1908) 48; WHITFORD, Philip. J. Sc. 4 (1910) Bot. 703; Bull. Bur. For. Philip. 10 (1911) 61; FOXW. Philip. J. Sc. 4 (1910) Bot. 511; *ibid.* 6 (1911) Bot. 266; *ibid.* 13 (1918) Bot. 186; *ibid.* 67 (1938) 287; MERR. En. Philip. 3 (1923) 95; REYES, Philip. J. Sc. 22 (1923) 332. — *Pentacme paucinervis* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 73. — *Pentacme mindanensis* FOXW. Philip. J. Sc. 13 (1918) Bot. 185; *ibid.* 67 (1938) 289; MERR. En. Philip. 3 (1923) 95; REYES, Philip. J. Sc. 22 (1923) 332. — Fig. 84.

Medium-sized, sometimes large evergreen V-fisured buttressed tree. Panicle, parts of petals exposed in bud, ovary and leaf buds densely persistently pale brown puberulent, twigs, petioles and calyx outside caducously so. *Twig* c. 2 mm  $\varnothing$  apically, terete or  $\pm$  ribbed; stipule scars short, descending. *Leaf buds* to 6 by 3 mm, lanceolate; *stipules* fugaceous. *Leaves* 9–29 by 5.5–11 cm, ovate to lanceolate, thinly coriaceous; base subequal, obtuse or rarely cordate (subpeltate in young trees); apex broadly to 1 cm long acuminate; nerves 5–8(–9) pairs, slender but prominent beneath, distant, arched,  $\pm$  applanate above as also the midrib, set at  $45^{\circ}$ – $70^{\circ}$ ; tertiary nerves densely scalariform, slender, hardly elevated on either surface; *petioles* 20–33 mm long, slender. *Panicles* to 22 cm long (if terminal), to 14 cm long (if axillary), singly or doubly branched; branchlets to 4 cm long. *Flower buds* to 8 by 4 mm, ovoid, lanceolate; *sepals* ovate, obtuse, the outer 3 somewhat the larger; *petals* broadly oblong-elliptic, acute; *stamens* 15, subequal; filaments short, broad, applanate; anther cells linear, subequal, prolonged into prominent distal horns c.  $\frac{1}{2}$  their length and as long as the stout appendage; *style* columnar, c. thrice length of ovary. *Fruit* shortly pedicellate; 3 longer *calyx lobes* to 12 by 3 cm, spatulate, obtuse, tapering to c. 8 mm wide at the incrassate saccate base; 2 shorter lobes to 9 by 1.5 cm, otherwise similar; *nut* to 35 by 15 mm, narrowly ovoid, apiculate.

Distr. *Malesia*: throughout the Philippines.

Ecol. Common, often semi-gregarious in more or less seasonal Semi-evergreen Dipterocarp forests in the lowlands, uncommon in everwet areas.

Vern. *Malaanonan*, *lauan*.

Note. Leaves of Mindanao and some other specimens in the non-seasonal areas are usually longer leaved, and formerly named *Pentacme mindanensis* (cf. *S. falciferoides*, *S. polysperma*).

### 3. Section *Neohopea*

ASHTON, Gard. Bull. Sing. 20 (1963) 266; Man. Dipt. Brun. (1964) 116. — Fig. 85.

*Flower* small, cream, bud globose. *Petals* broadly elliptic, falling separately. *Stamens* 15, in 3 verticils; filaments stout, short, compressed, hardly tapering; anthers with 4 pollen sacs, subglobose; appendage to connective hardly exceeding anther apex, short, stout, glabrous. *Ovary* and *stylopodium* conical, both puberulent; style very short. *Stipules* and *bracts* minute, fugaceous. *Leaf* with

scalariform tertiary nerves; midrib broad, evident above. Bark and wood as in *sect. Shorea*.

Distr. & Ecol. See under the species.

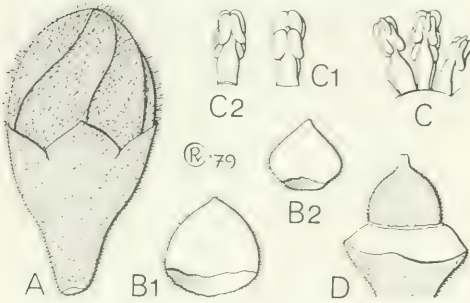


Fig. 85. Flower details in *Shorea sect. Neohopea* ASHTON. — *S. isoptera* ASHTON. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C. stamens abaxial view, C1. outside view on staminal group, C2. inside view on staminal group, D. pistil, all  $\times 10$  (BRUN 3018).

**38. *Shorea isoptera*** ASHTON, Gard. Bull. Sing. 19 (1962) 293, pl. 20; Man. Dipt. Brun. (1964) 137, f. 13; *ibid.* Suppl. (1968) 73; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 189, f. 19. — **Fig. 85, 86.**

Tall, stoutly buttressed tree. All vegetative parts glabrous. *Twig* to 1.5 mm  $\varnothing$  apically, slender, smooth, terete; stipule scars short, obscure. *Bud* to 1.5 mm long, small, globose. *Stipule* caducous, unknown. *Leaves* 9–16 by 5.8–8 cm, ovate; base broadly cuneate to obtuse, decurrent to 2 mm down petiole (peltate in saplings); acumen to 1.5 cm long, narrow; margin undulate; nerves 9–11 pairs, curved, slightly raised beneath, depressed above, at 45°–65°; tertiary nerves scalariform, sinuate, slender; midrib terete, slightly

elevated, beneath,  $\pm$  applanate above; *petiole* 1.3–2 cm long. *Panicle* to 11 cm long, terminal or to 3-axillary, terete or somewhat compressed, lax, shortly persistently greyish puberulent; regularly alternately doubly branched, branches to 5 cm long, branchlets to 1 cm long, short, bearing to 6 close secund flowers; *bracts* unknown; *bracteoles* to 1 mm long, linear, pubescent, fugaceous. *Flower bud* to 1.5 mm long, globose. *Calyx* shortly pubescent outside, glabrous within; lobes subequal, imbricate, acute; 3 outer lobes ovate, 2 inner lobes deltoid. *Petals* densely pubescent outside, shortly sparsely pubescent within, oblong, obtuse, strongly contorted. *Stamens* 15, in 3 verticils, double alternating with single stamens; filaments broad, compressed, hardly tapering, glabrous; anthers oblong-globose, pollen sacs subequal or the outer somewhat larger; appendage to connective short, stout, glabrous, not exceeding the anther apex. *Ovary* and *stylopodium* ovoid-conical, glabrous at base, puberulent near apex, crowned abruptly by a short glabrous style; stigma minute. *Fruit calyx* glabrescent to puberulent at base; lobes to 5.5 by 1.5 cm, subequal, spatulate, obtuse, to 5 mm broad above the slightly broader saccate base, rotate when ripe, narrowly imbricate at base. *Nut* to 9 by 10 mm, ovoid, broader than long, shortly pale grey-brown pubescent, on an up to 8 mm  $\varnothing$  broad shallow receptacle; style remnant to 4 mm long, tapering.

Distr. *Malesia*: Northern Borneo (Sarawak, S.W. Sabah and Sandakan Distr.).

Ecol. Locally frequent on clay rich  $\pm$  calcareous soils, and on limestone scarps, on low hills below 600 m.

Vern. *Sēlangan batu gēombang*, s.b. *main bulu ayam*.

Note. An isolated species whose fruit, with broad shallow receptacle and subequal sepals, and androe-cium are unique.

#### 4. Section *Richetioides*

HEIM. Rech. Dipt. (1892) 48; ASHTON, Gard. Bull. Sing. 20 (1963) 267; Man. Dipt. Brun. (1964) 116; Gard. Bull. Sing. 22 (1967) 288. — *Richetia* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 975. — *Shorea*, *Richetia* group SYM. Gard. Bull. S. S. 9 (1938) 330; Mal. For. Rec. 16 (1943) 44, f. 27 (map). — *Shorea*, *Meranti Damar Hitam* group SYM. Gard. Bull. S. S. 9 (1938) 330; Mal. For. Rec. 16 (1943) 2, 44. — *Shorea subg. Richetia* (HEIM) MEIJER, Act. Bot. Neerl. 12 (1963) 322, *nom. inval.* — **Fig. 87, 89.**

*Flowers* usually small, usually bright lemon yellow or pale yellow; *petals* narrow, strongly twisted and forming a sharply defined though small cup at base enclosing anthers at anthesis, falling as a rosette. *Leaf* with  $\pm$  reticulate pellucid





Fig. 86. *Shorea isoptera* ASHTON. a. Flowering twig, b. fruit, c. nut, all  $\times \frac{1}{2}$  (a S 17978, b-c SAN 15222).

tertiary nerves; midrib elevated or depressed above, evident. Young leaves often deep violet or magenta. Large or small trees, the larger with stout prominent buttresses. *Bark* usually appearing scaly; phelloderm thin, inconspicuous; expansion tissue in long fingers, becoming wider outwards.

Distr. & Ecol. See under the species.

Vern. *Damar hitam* (Mal.), *lun* (Sarawak), *mèrakunyat* (Sum., Dayak), *sèraya kuning* (Sabah).

#### 4a. Subsection *Polyandrae*

ASHTON, Gard. Bull. Sing. 22 (1967) 288. — **Fig. 87.**

*Bud* large, broadly ovoid. *Stamens*  $\infty$ ; filaments compressed at base, tapering; anthers narrowly oblong; appendages to connectives somewhat shorter than anther apices, densely setose. *Ovary* ovoid, without stylopodium, pubescent; style short, broad, prominently trifurcate.

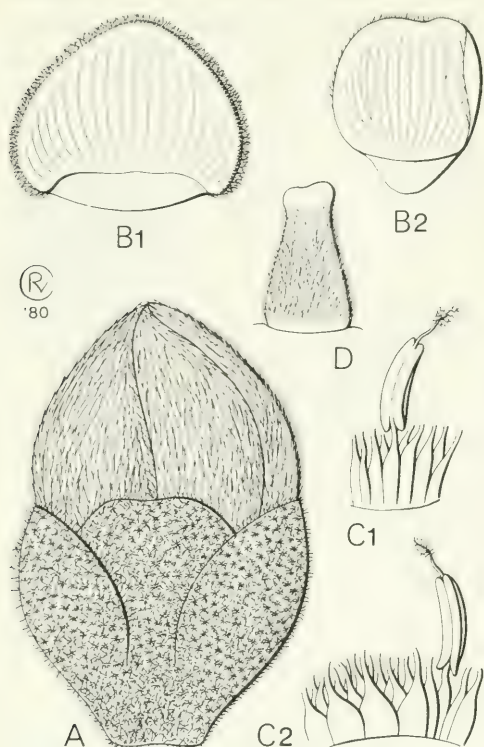


Fig. 87. Flower details in *Shorea* sect. *Richetioides* HEIM subsect. *Polyandrae* ASHTON. — *S. polyandra* ASHTON. A. Bud, B1. outer sepal, B2. inner sepal, both from inside, C1. staminal group from outside, C2. staminal group from inside, D. pistil, all  $\times 10$  (KOSTERMANS 13302).

39. *Shorea polyandra* ASHTON, Gard. Bull. Sing. 22 (1967) 286, pl. 32; Man. Dipt. Brun. Suppl. (1968), f. 11. — Fig. 87, 88.

Very large, buttressed tree. Twig, petiole and leaf beneath persistently purplish rufous lepidote, fading to grey; bud and stipule persistently shortly purplish rufous puberulent. Twig c. 1 mm  $\varnothing$  apically, slender, terete, smooth or minutely striated; stipule scars short, horizontal, obscure. Bud to 2 by 1 mm, small, ellipsoid, subacute. Stipule to 5 by 2 mm, lanceolate, subacute, fugaceous. Leaves 8–13 by 3–5 cm, lanceolate, chartaceous, undulate; base cuneate; acumen to 2 cm long, slender; nerves 11–14 pairs, slender, elevated beneath, at  $40^{\circ}$ – $60^{\circ}$ ; tertiary nerves scalariform, slender, at  $90^{\circ}$  to the midrib; midrib slender, evident, applanate above, prominent beneath; petiole 14–20 mm long, slender. Panicle to 6 cm long, terminal or axillary, terete, densely dark rufous pubescent; singly branched, branchlets to 1 cm long, bearing to 3 more or less distichous flowers; bracteoles to 4 by 3 mm, elliptic, subacute, rufous pubescent, caducous. Flower bud to 5 by 4 mm, broadly ovoid. Calyx sericeous on parts exposed in bud; lobes suborbicular, subequal. Petals oblong, obtuse, densely pubescent on parts exposed in bud. Stamens 102–107, very many, subequal; filament compressed at base, tapering, c.  $\frac{1}{2}$  length of anther, anther narrowly oblong, c. 4 times as long as broad; appendage to connective filiform, tapering, somewhat shorter than length of anther, densely pubescent. Ovary ovoid, densely pubescent, tapering into a short broadly columnar trifid style; style pubescent except at apex. Fruit pedicel to 1 mm long, short. Calyx sparsely purplish rufous pubescent towards the base, elsewhere glabrescent; 3 longer lobes to 8 by 1.4 cm, spatulate, obtuse or subacute, tapering to 8 mm broad above the to 10 by 8 mm tuberculate saccate thickened base; 2 shorter lobes to 5 by 0.5 cm, linear, acute, similar at base. Nut to 30 by 13 mm, narrowly ovoid, acute, densely rufous pubescent.

Distr. *Malesia*: Borneo (Ulu Kapuas, Sarawak, S. E. Sabah, S. E. Borneo to Pulau Laut and Meratus mountains).

Ecol. Locally abundant on fertile clay rich soils on calcareous shales, igneous and volcanic rocks below 600 m.

Vern. *Putang lēnit*, *p. bēsi*, *mērakunyit*, *damar hirang*, *d. kētuyang*, *d. kuning*, *d. jangkar*, *kēlapih pahit*, *lodan*, *duku mintola*.

#### 4b. Subsection *Richetioides*

ASHTON, Gard. Bull. Sing. 22 (1967) 288. — Fig. 89.

Flowers usually small, buds fusiform. Stamens (10–)15, in (2–)3 verticils; filaments broad at base, frequently gibbous, tapering  $\pm$  abruptly medially, filiform distally; anthers broadly oblong to subglobose; appendages to connectives longer than anthers,  $\pm$  scabrous towards apex. Ovary with stylopodium, shortly tomentose, with a slender columnar style.

Distr. Non-seasonal western *Malesia* including the Philippines.

Ecol. Lowland forests below 1500 m.

Notes. *S. multiflora* has been observed to be thrip-pollinated; in view of the uniformity of flower structure other species are likely to be also. Sympatric species flower sequentially. The short-sepalled species do not form a





Fig. 88. *Shorea polyandra* ASHTON. a. Sterile twig. b. flowering twig. c. fruit. d. nut. all  $\times 2.3$  (a bb. 31167. b KOSTERMANS 13302, c-d bb. 12375).

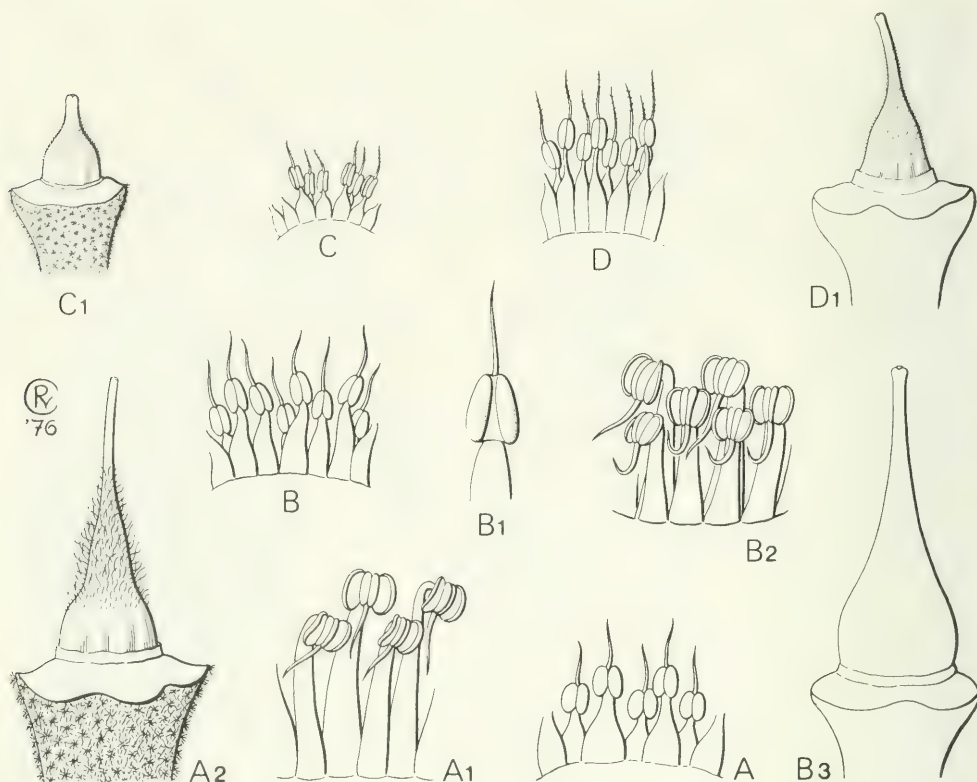


Fig. 89. Flower details in *Shorea* sect. *Richetioides* HEIM subsect. *Richetioides*. All  $\times 10$ , except *B1*. — *S. maxima* (KING) SYM. A. Young stamens from inside, A1. mature stamens from outside, A2. pistil. — *S. longiflora* (BRANDIS) SYM. B. Young stamens from inside. B1. anther of young stamen,  $\times 20$ . B2. mature stamens from outside, B3. pistil. — *S. angustifolia* ASHTON. C. Stamens from inside, C1. pistil. — *S. richetia* SYM. D. Stamens from inside, D1. pistil (A KEP 80222, B S 19425, C BRUN 778, D ROSLI s.n., tree 121).

natural group and some form species pairs with long-sepalled species, as in *S. multiflora* and *S. hopeifolia*. Species with long fruit sepals are invariably emergent, whereas most with short sepalled are of the main canopy and understorey. Endemism is heavily predominant among short sepalled species, while several of the widespread species, e.g., *S. gibbosa*, *S. faguetiana*, and *S. hopeifolia* (long-sepalled) and *S. multiflora* (short-sepalled) show complex geographical variation, some of which I recognize as local sibling species (*S. mujongensis*, *S. cuspidata*, *S. alutacea* of *S. gibbosa*; *S. iliasii*, *S. kuantanensis*, *S. kudatensis* of *S. faguetiana*; *S. richetia* of *S. multiflora*). Such patterns recall those of *S. macroptera* and its allies in sect. *Mutica* subsect. *Auriculatae* where apomixis through adventive embryony is known to occur.

**40. *Shorea kuantanensis* ASHTON, Gard. Bull. Sing. 31 (1978) 41.**

Medium-sized tree. Twig apices and leaf buds sparsely buff puberulent, ovary densely so. Twig c. 2 mm  $\varnothing$  apically, terete, striated. Leaves 7.5–12 by 2.7–5 cm, lanceolate, thinly coriaceous; base cuneate, subequal; acuminate to 1 cm long, slender; margin subrevolute; nerves 8–9 pairs, slender but elevated beneath, obscurely depressed above; tertiary nerves reticulate;

midrib prominent beneath, hardly elevated above; petiole 15–18 mm long, slender. Panicles and flowers unknown. Fruit pedicel to 4 mm long, expanding into the fruit base; calyx lobes  $\pm$  subequal, to 22 by 4 mm, linear except at the expanded incrassate saccate base; nut to 25 by 11 mm, narrowly ellipsoid, acute, exceeding fruit sepals.

Distr. Malesia: Malaya (Bukit Goh forest, Kuantan).



Ecol. Apparently once, frequent on the basalt soils in this one locality, now converted to plantation.

Vern. *Damar hitam*.

**41. *Shorea longiflora*** (BRANDIS) SYM. Gard. Bull. S. S. 9 (1938) 330; SLOOT. Reinwardtia 3 (1956) 318; BROWNE, For. Trees Sarawak & Brunei (1955) 163; ANDERSON, Gard. Bull. Sing. 20 (1963) 158; ASHTON, Man. Dipt. Brun. (1964) 156, f. 14; *ibid.* Suppl. (1968) 86. — *Hopea longiflora* BRANDIS, J. Linn. Soc. Bot. 31 (1885) 63. — *Hopea longifolia* (non DYER) MERR. En. Born. (1921) 402. — *Balanocarpus longiflorus* FOXW. ex SYM. Gard. Bull. S. S. 8 (1934) 29, pl. 7. — *Balanocarpus grandifolius* RIDL. ex SYM. Gard. Bull. S. S. 8 (1934) 29, *nomen in syn.* — **Fig. 89 B–B3, 90.**

Small, frequently crooked, tree, Young twig, panicle, bud and stipule fulvous powdery pubescent, caducous on twig and petiole. *Twig* to 2.5 mm  $\varnothing$  apically, terete, stout, becoming striated and papery flaked. *Bud* to 3 by 2 mm, slightly compressed, globose to ellipsoid. *Stipule* to 10 by 6 mm, oblong-elliptic, obtuse, cupped. *Leaves* 10–24 by 4–6 cm, narrowly ovate to lanceolate, coriaceous; base obtuse; acumen narrowly acute, 1–2 cm long; margin prominently revolute; nerves 12–15 pairs, distant, prominent beneath, at 60°–70°; tertiary nerves broadly scalariform; *petiole* 1–1.2 cm long, short. *Panicle* to 11 cm long, terminal or axillary, terete; unbranched or singly branched; bracteoles minute, fugaceous. *Flower bud* to 8 by 3.5 mm, lanceolate, relatively large. *Calyx* glabrous but for the shortly fimbriate margin; lobes broadly ovate, thickened, the inner 2 somewhat smaller, thinner, more constricted basally, shortly acuminate, the outer 3 obtuse. *Petals* brownish purple to dark yellow, linear, strongly contorted, inner margin shortly setose, puberulent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments stout, gradually tapering; anther oblong, becoming  $\pm$  reflexed at anthesis; appendage to connective as long as anther, sparsely ciliate towards apex. *Ovary* small, ovoid, glabrous; stylopodium glabrous, slender, tapering; style glabrous; stylopodium and style about twice length of ovary. *Fruit* subsessile; *calyx* glabrous, lobes subequal, *c.* 7 mm long and broad, broadly deltoid to ovate, rather thin, striated, not adpressed to the base of the nut but somewhat spreading with the apices turned slightly inwards. *Nut* to 4.5 by 1.7 cm, lustrous, glabrous, finely striated, ellipsoid to sub-ovoid or obovoid, often bent over to one side; style remnant short, acute.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Sangkulirang and Lower Mahakam region in south-east).

Ecol. Shallow peat swamps and rarely yellow sandy soils, on low hills and plateaux to 1000 m.

Vern. *Damar hitam paya* (Brun.), *lun paya* (Sar.).

**42. *Shorea macrobalanos*** ASHTON, Gard. Bull. Sing. 22 (1967) 202, pl. 37; Man. Dipt. Brun. Suppl. (1968) 86, f. 11.

Tall spreading tree. Leaf bud and stipule persistently buff pubescent, otherwise glabrous. *Twig* *c.* 4

mm  $\varnothing$  apically, terete, becoming prominently verrucose; stipule scars *c.* 3 mm long, obscure, ascending. *Leaf bud* to 2 by 2 mm, ovoid, acute. *Stipule* unknown. *Leaves* 19–37 by 9–15 cm, oblong, coriaceous; margin revolute; base cordate; apex shortly broadly acuminate or obtuse; nerves 12–16 pairs, prominent beneath, set obliquely at 45°–65°; tertiary nerves slender, remotely subreticulate; midrib appanate above, prominent beneath; *petiole* 1.8–3.8 cm long, stout. *Panicle* to 32 cm long, terminal or axillary, terete to somewhat compressed, glabrous, pale brown, becoming rugose, singly or doubly branched. *Flower* to 9 by 3.5 mm, lanceolate, large. *Calyx* glabrous; lobes broadly ovate, thickened; inner 2 somewhat smaller than outer 3. *Petals* linear, inner margin shortly setose, puberulent on parts exposed in bud. *Stamens* 10, in a single verticil; filaments slender, tapering; anthers broadly oblong; appendages to connective as long as anther. *Ovary* narrowly ovoid, tapering, densely yellow-brown pubescent; style glabrous. *Fruit* sessile, entirely glabrous; *calyx lobes* to 8 by 8 mm, ovate, acute,  $\pm$  undulate and subrotate, not closely adpressed to the nut, mounted on a to 1 cm  $\varnothing$ , to 8 mm deep, receptacle. *Nut* to 5 by 2.5 cm, large, oblong, shortly apiculate.

Distr. *Malesia*: Borneo (W. and Central Sarawak; E. Kalimantan: W. Kutei).

Ecol. Rare, clay rich soils on undulating land and ridges to 900 m.

Vern. *Engkabang low* (Sar.).

**43. *Shorea peltata*** SYM. J. Mal. Br. R. As. Soc. 19 (1941) 158, pl. 6; Mal. For. Rec. 16 (1943) 56, f. 29; DESCH, Mal. For. Rec. 14 (1941) 27; SLOOT. Reinwardtia 3 (1956) 337, f. 8.

Small tree. Panicles, petals outside and nut persistently densely buff puberulent, calyx outside caducously so, parts of petals exposed in bud puberulent; other parts glabrous. *Twig* *c.* 2 mm  $\varnothing$  apically, terete, smooth. *Buds* minute, ovoid, acute. *Stipules* unknown. *Leaves* 8–16 by 4–7.5 cm, oblong, chartaceous, prominently peltate; acumen to 1 cm long, cuspidate; nerves 8–9 pairs the first 3 of which arise from the petiole insertion, arched, slender but distinctly raised beneath, elevated above as also the subreticulate tertiaries and terete midrib; *petiole* 1.8–3 cm long, slender. *Panicle* to 14 cm long, terminal or subterminal axillary, with to 1 cm long branchlets bearing to 5 second flowers. *Flower buds* to 6 mm long, lanceolate; *sepals* ovate, acute, subequal; *petals* yellow; *stamens* 15, in 3 unequal verticils; filaments broad at base, tapering and filiform beneath the broadly ellipsoid anthers; appendages *c.* 1½ times length of anther, scabrous towards the apex, slender; *ovary* ovoid, sericeous distally, crowned by a glabrous columnar style equal in length. *Fruit* subsessile; *calyx lobes* to 8 by 5 mm, short, subequal, ovate, acute, incrassate, tuberculate; *nut* to 30 by 9 mm, fusiform, tapering, acute.

Distr. *Malesia*: S. E. Malaya (N. E. Johore), E. Sumatra (Indragiri Uplands), West Borneo.



Fig. 90. *Shorea longiflora* (BRANDIS) SYM. with narrow, thick leaves. Brunei (Photogr. G.H.S. WOOD, SAN 17535).

Ecol. Locally common or even gregarious, on well-drained flat land or low hills in Mixed Dipterocarp forest.

Vern. *Mēranti telepok*, *sama rupa mēranti* (Malaya), *manga* (Sumatra).

44. *Shorea richetia* SYM. Gard. Bull. S. S. 9 (1938) 330; SLOOT. Reinwardtia 3 (1956) 335, f. 6; ASHTON, Man. Dipt. Brun. Suppl. (1968) 89, f. 11, pl. 15 (slash). — *Richetia coriacea* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 975. — *Balanocarpus coriaceus* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 112; SYM. Gard. Bull. S. S. 8 (1934) 27; MERR. En. Born. (1921) 407. — Fig. 89 D–D1.

Medium-sized tree. Apices of twigs, buds and stipules puberulent, other vegetative parts glabrous. Twig 1–2 mm  $\varnothing$  apically, terete, smooth, pale grey-brown; stipule scars short, horizontal, obscure. Bud to 2 by 2 mm, ovoid, subacute. Stipule to 5 by 2 mm, lanceolate, acute. Leaves 5–11 by 3–6.5 cm, broadly elliptic, thickly coriaceous; base broadly cuneate; acumen to 1 cm long; nerves 5–7 pairs, comparatively stout and prominent beneath, arched, at 45°–65°; tertiary nerves subscalariform; midrib appanate to slightly depressed above, prominent beneath; petiole 6–10 mm long, stout. Panicle to 8 cm long, terminal or axillary, compressed or terete, lax, buff puberulent or

glabrous; singly branched, branchlets bearing to 5  $\pm$  distichous flowers. Buds to 7 by 2 mm, fusiform. Sepals broadly ovate, fimbriate but otherwise glabrous; outer 3 acute, inner 2 relatively broader, thinner at margin. Petals lime-yellow, lanceolate, densely pubescent on parts exposed in bud, imbricate at base after opening forming a cup, spreading and contorted apically. Stamens 16–17 in 3 unequal verticils; filaments compressed as base, tapering and filiform below the broadly ellipsoid anthers; appendage to connective slender, c. 1½ times length of anther, pubescent in the distal ½. Ovary ovoid, densely pubescent; style columnar, tapering, 2–3 times as long as ovary, pubescent in the basal ½. Fruit pedicel to 2 mm long, stout. Calyx glabrous; lobes to 1.7 by 1 cm, subequal, narrowly ovate, acute, incrassate, saccate and tuberculate at base. Nut to 2.5 by 1.5 cm, obovoid, acute, densely shortly persistently buff pubescent.

Distr. Malesia: N. W. Borneo (W. Sarawak and lower Kapuas valley).

Ecol. Local, on leached soils on undulating land in Mixed Dipterocarp and Heath forest.

Vern. *Lun mēlapi*.

45. *Shorea laxa* SLOOT. Reinwardtia 3 (1956) 345; ASHTON, Man. Dipt. Brun. (1964) 155, f. 14, pl. 38 (habit, saplings); *ibid.* Suppl. (1968) 86, pl. 16 (bark); MEIJER & WOOD, Sabah For. Rec. 5 (1964) 75. — *S. peltata* (non SYM.) BROWNE, For. Trees Sarawak & Brunei (1955) 164.

Medium-sized to large tree. Bud, stipule outside, twig, panicle, petiole and the basal half of the midrib beneath persistently shortly  $\pm$  sparsely pale cream-brown pubescent. Twig 2 mm  $\varnothing$  apically, smooth. Bud c. 3 by 2 mm, globose to ovoid, subacute. Stipule to 5 by 2 mm, fugaceous, lanceolate, acute. Leaves 7–14 by 4–9 cm, ovate to elliptic, coriaceous; base obtuse or broadly cuneate; acumen c. 1–1.5 cm long, narrow; margin slightly revolute; nerves 8–10 pairs, prominent beneath, at 50°–85° towards the base and 30°–40° at the apex, curved and following the margin for a short distance distally; tertiary nerves well spaced, scalariform; petiole 1.5–2.2 cm long. Panicle to 18 cm long, terminal or axillary, terete, slender, lax; irregularly doubly branched, branchlets to 3 cm long bearing to 7  $\pm$  distichous flowers; bracteoles to 1.5 mm long, minute, fugaceous. Flower bud to 8 by 2 mm, relatively large, lanceolate, acute. Calyx shortly cream pubescent outside, glabrous within; lobes ovate, acute, shortly acuminate, the inner 2 slightly smaller, thinner, basally constricted, with a pronouncedly setose margin. Petals cream, linear, pubescent on parts exposed in bud, imbricate at base and forming a small cup on opening, spreading distally but hardly twisted. Stamens 15, in 3 unequal verticils; filaments slender, tapering, hardly gibbous; anthers subglobose; appendage to connective twice length of anther, slender, reaching base of style, shortly ciliate towards apex. Ovary and stylopodium ovoid-conical, densely shortly pubescent, tapering distally; style short, densely setose in basal half, otherwise glabrous. Fruit calyx glabrous,



lobes subequal, c. 1 cm long and broad, broadly ovate, thickened at the base, tuberculate, closely adpressed to the base of the nut, the obtuse thin apices recurved. *Nut* c. 3.5 by 2.5 cm, large, broadly obovoid, shortly buff pubescent, splitting open at germination unevenly to reveal brilliant red cotyledons.

Distr. *Malesia*: N. E. Borneo (N. E. Sarawak, Brunei, S. E. Sabah).

Ecol. Local, deep yellow sandy soils, Mixed Dipterocarp forest on hills near coast; on ultrabasics in Sabah.

Vern. *Damar hitam timbul* (Brun.).

**46. *Shorea balanocarpoides*** SYM. Gard. Bull. S. S. 9 (1938) 330; Mal. For. Rec. 16 (1943) 47, f. 29, 30; DESCH. Mal. For. Rec. 14 (1941) 27, 28; *ibid.* 15 (1941) 127; SLOOT. Reinwardtia 3 (1956) 340, f. 9. — *Balanocarpus pahangensis* FOXW. Mal. For. Rec. 10 (1932) 145; BURK. Dict. (1935) 287; DESCH. Mal. For. Rec. 12 (1936) 37, 38. — *S. dolichocarpa* SLOOT. Reinwardtia 3 (1956) 342; ASHTON, Man. Dipt. Brun. (1964) 151, f. 14; *ibid.* Suppl. (1968) 83.

Small to medium-sized tree. Young twig, leaf bud, stipule outside, panicle and buds shortly sparsely grey puberulent, otherwise glabrous. *Twig* c. 1.5 mm  $\varnothing$  apically, terete, much branched. *Bud* to 2 by 1.5 mm, small, globose to ovoid, obtuse. *Stipule* to 4 mm long, linear, fugaceous. *Leaves* 6–12 by 2–7 cm, coriaceous,  $\pm$  ovate; base obtuse or broadly cuneate, usually unequal, decurrent to 1.5 mm along the petiole; acumen to 1 cm long, narrow; nerves 5–7 pairs, strongly curved, widely spaced, at 60°–70°, running parallel to the margin for a short distance distally; tertiary nerves distant, scalariform at the margin, reticulate near the midrib; *petiole* 1.2–2 cm long. *Panicle* to 8 cm long, terminal or axillary, slender, terete; somewhat irregularly doubly branched, branchlets to 1.5 cm long, short, frequently zigzag, bearing to 8 distichous flowers; *bracteoles* minute, fugaceous. *Flower bud* to 4.5 by 1.2 mm, lanceolate, acute. *Calyx* shortly pubescent outside, glabrous within; 3 outer lobes deltoid, acute; 2 inner lobes subequal to them, suborbicular, mucronate, thin. *Petals* yellow-brown with bright yellow margin, linear, puberulent on parts exposed in bud, imbricate in basal half, spreading and twisted distally when opened. *Stamens* 15, in 3 slightly unequal verticils; filaments broad and slightly gibbous at base, tapering and filiform distally; anther broadly oblong to subglobose; appendage to connective somewhat longer than anther, shortly ciliate towards apex. *Ovary* and *stylopodium* conical, glabrescent, tapering; style short, stout, glabrous. *Fruit* subsessile; *calyx lobes* c. 5 mm long and broad, equal, short, deltoid, subacute, glabrous, saccate and closely adpressed to the nut, margin slightly revolute. *Nut* to 3 by 1.3 cm, ellipsoid to obovoid, densely evenly pubescent, appearing distinctly purplish; style remnant short, acute.

Distr. *Malesia*: Malaya (Kedah, Perak, E. coast), Sumatra (Atjeh; Langkat), Borneo (Sarawak N.E. of Rejang valley and Brunei).

Ecol. Common in Mixed Dipterocarp forest on undulating ground and on ridges to 700 m.

Vern. *Damar katup, mērawan, m. hijau, kala daun bēsar, damar hitam d.b.* (Malaya), *damar hitam gondol* (Brun.).

**47. *Shorea multiflora*** (BURCK) SYM. Gard. Bull. S. S. 9 (1938) 330; Mal. For. Rec. 16 (1943) 54, f. 28, 29, 33, 34; DESCH. Mal. For. Rec. 14 (1941) 27, 28; *ibid.* 15 (1941) 127; SLOOT. Reinwardtia 3 (1956) 320, f. 1; BROWNE, For. Trees Sarawak & Brunei (1955) 63; ASHTON, Man. Dipt. Brun. (1964) 157, f. 14, pl. 39 (bark); *ibid.* Suppl. (1968) 87; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 76, f. 1b. — *Doona multiflora* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 234. — *Richetia latifolia* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 976. — *Richetia acuminata* HEIM, l.c. 979. — *Richetia oblongifolia* HEIM, l.c. 979. — *Richetia penangiana* HEIM, l.c. 980; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 268. — *Balanocarpus penangianus* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 131; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 268; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 109; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 158, t. 191; BURK. J. Str. Br. R. As. Soc. 81 (1920) 65, fig.; Dict. (1935) 287; RIDL. Fl. Mal. Pen. 1 (1922) 246; FOXW. Mal. For. Rec. 1 (1921) 66; *ib.* 3 (1927) 58; *ib.* 8 (1930) 11; *ibid.* 10 (1932) 143; RIDL. Fl. Mal. Pen. 1 (1922) 246. — *Hopea multiflora* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 60; BOERL. Cat. Hort. Bog. 2 (1901) 102, *incl. var. venosa* BOERL.; RIDL. Fl. Mal. Pen. 1 (1922) 237; FOXW. Mal. For. Rec. 10 (1932) 110; BURK. Dict. (1935) 1191. — *Balanocarpus latifolius* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 112; MERR. En. Born. (1921) 407; FOXW. Mal. For. Rec. 10 (1932) 145; BURK. Dict. (1935) 286. — *Balanocarpus acuminatus* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 113; MERR. En. Born. (1921) 407. — *Balanocarpus sibogae* BOERL. Cat. Hort. Bog. 2 (1901) 112. — *Balanocarpus* sp. SLOOT. ex MERR. Pl. Elm. Born. (1929) 200. — *Balanocarpus multiflorus* SYM. Gard. Bull. S. S. 7 (1933) 153, pl. 47; DESCH. Mal. For. Rec. 12 (1936) 37, 38. — **Fig. 5.**

Small to medium-sized, occasionally large tree. Young twig, petiole, stipule outside and bud shortly grey tomentose, caducous on twig and petiole. *Twig* c. 1 mm  $\varnothing$  apically, slender, terete, smooth, much branched. *Bud* 1–2 by 1.5–2 mm, small, ovoid, obtuse or acute. *Stipule* to 6 by 2 mm, narrowly lanceolate, acute, fugaceous. *Leaves* 4.5–7.5 by 2–3.5 cm, small, ovate-lanceolate; base cuneate, equal or subequal, with or without paired domatia; acumen to 1.5 cm long, narrow; nerves 8–10 pairs, very slender and barely elevated beneath, distant, at 50°–60°; tertiary nerves scalariform to reticulate; *petiole* 7–10 mm long, slender. *Panicle* to 16 cm long, terminal or axillary, terete, lax, shortly sparsely or densely evenly persistently pale cream-buff pubescent; regularly doubly, rarely trebly, branched, branchlets to 1 cm long, zigzag, bearing to 9 distichous flowers; *bracteoles* minute, fugaceous. *Flower bud* to 2.5 mm long, small, lanceolate. *Calyx* shortly cream pubescent outside,

glabrous within; lobes ovate, acute, the inner 2 slightly thinner, more constricted at the base. *Petals* pale yellow, linear, pubescent on parts exposed in bud, the basal  $\frac{1}{2}$  imbricate forming a cup, twisted and spreading distally. *Stamens* (10)–15, in (1)–3 slightly unequal verticils; filaments short, broad at base, tapering, filiform distally; anther subglobose; appendage to connective  $1\frac{1}{2}$ –2 times length of anther, reaching base of style, shortly ciliate distally. *Ovary* ovoid, tapering, shortly pubescent; stylopodium pubescent, tapering; style short, glabrous; the 2 latter as long as ovary. *Fruit calyx* puberulent to glabrous but for fimbriate margin; lobes to 5 by 4 mm, equal, deltoid, thickened, saccate, subacute. *Nut* to 2 by 1.2 cm, obovoid, finely striated longitudinally, glabrous and lustrous or shortly grey pubescent; style remnant mucronate.

Distr. *Malesia*: Malaya, Sumatra (Karimun, Tapan S.E. to Langsa, Tapanuli, and Palembang, S.W. to Sibolga, Pariaman, Painan), Borneo.

Ecol. Widespread and common, on low hills near coast and inland ridges to 700 m, in Heath and Mixed Dipterocarp forest.

Vern. *Damar hitam*, *d. katup*, *sēnggai* (Mal.), *d. tanduk*, *d. hitam*, *d. siput*, *riung*, *mēranti kēpala rusa*, *mandirawan*, *kēpala tupai*, *d. rēsak hitam manis* (Sumatra), *tismantok* (Murut), *banjutan* (Dusun), *loan sane barit*, *bunbun puteh*, *bambēring*, *mandjin bukit*, *kēpala pipit*, *puting dēlatit* (Indon. Borneo).

**48. *Shorea patoiensis*** ASHTON, Gard. Bull. Sing. 19 (1962) 302, pl. 24; Man. Dipt. Brun. (1964) 159, f. 14; *ibid.* Suppl. (1968) 88; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 78.

Medium-sized tree. Vegetative parts glabrous but for the fimbriate stipule and bud scales and frequently a white waxy powder on young buds and twigs in mature trees. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched in mature trees, terete, smooth or rugulose. *Leaf bud* c. 3 by 1 mm (to 4 by 2 mm in young trees), narrowly ovoid, obtuse with the bud scales conspicuously patent. *Stipule* c. 8 by 2 mm, glabrous but for margin, oblong, acute. *Leaves* 5–8 by 2–3.5 cm, ovate, chartaceous, frequently subfalcate; base  $\pm$  broadly cuneate, decurrent for up to 1 mm at the petiole insertion; acumen c. 1 cm long, narrow; nerves 7–9 pairs, curved, set obliquely ( $35^{\circ}$ – $45^{\circ}$ ), slightly elevated above, slender but prominent beneath; tertiary nerves densely scalariform; *petiole* 7–10 mm long. *Panicle* to 9 cm long, terminal or axillary, rather short and compact, slender, terete, shortly persistently pale greyish brown pubescent; singly or doubly branched, branchlets to 1 cm long, bearing to 6 flowers; *bracteoles* minute, fugaceous. *Flower bud* to 3.5 by 1.5 mm, lanceolate, acute. *Calyx* densely reddish brown pubescent; lobes very small, suborbicular, obtuse, the inner 2 somewhat thinner, constricted at the base. *Petals* bright lemon-yellow, linear, imbricate and forming a cup at the base, twisted and spreading apically. *Stamens* 15, in unequal verticils; filaments rather short, broad at base, abruptly tapering and filiform distally; anther subglobose; appendage to

connective as long as anther, shortly ciliate towards the apex, reaching almost to the style apex. *Ovary* ovoid, shortly pubescent; stylopodium cylindrical, pubescent; style short, glabrous. *Fruit calyx* shorter than nut, caducous yellowish buff pubescent, margin persistently fimbriate; lobes 3–5 mm long and broad, subequal, broadly ovate,  $\pm$  adpressed to the base of the nut and united at the base to form a c. 5 mm  $\varnothing$  cup. *Nut* to 15 by 8 mm, small, oblong-ellipsoid, striated, glabrescent at maturity, with a minute style remnant.

Distr. *Malesia*: Northern Borneo (Central and N.E. Sarawak, S.E. Sabah, Tidung, E. Kutei).

Ecol. Local, on fertile clay rich soils on calcareous shales and volcanic rocks, hills below 500 m.

Vern. *Damar hitam padi* (Brun.), *sēraya kuning pinang* (Sabah), *njērakat* (Berau).

**49. *Shorea induplicata*** SLOOT. Reinwardtia 3 (1956) 327, f. 2; ASHTON, Man. Dipt. Brun. Suppl. (1968) 85, f. 10.

Medium-sized tree. Innovations pale rufous scabrid tomentose, turning dark grey-brown and persisting on twig, buds, stipule, petiole and leaf beneath. *Twig* c. 2 mm  $\varnothing$  apically, terete, becoming verruculose; stipule scars short, horizontal, obscure. *Bud* to 3 by 2 mm, ellipsoid, obtuse. *Stipule* c. 5 by 2 mm, linear, not at first caducous. *Leaves* 8–17 by 2–5 cm, lanceolate, coriaceous, margin revolute; base cordate; acumen to 2 cm long, slender; nerves 12–16 pairs, prominent beneath, at  $45^{\circ}$ – $55^{\circ}$  except at base; tertiary nerves subscalariform; midrib depressed above, prominent beneath; *petiole* 6–13 mm long, rather short. *Flowers* unknown. *Fruit pedicel* to 2 mm long. *Calyx* glabrescent; *lobes* to 8 by 6 mm, subequal, ovate, acute, the apices becoming subpatent, thickly incrassate. *Nut* to 2.5 by 2.0 cm, broadly ellipsoid, obovoid, subacute, densely shortly evenly fulvous pubescent.

Distr. *Malesia*: Borneo (North-west of the Kapuas and Lupar).

Ecol. Local on podsols on sandstone hills; Mixed Dipterocarp forest — Heath forest ecotone.

Vern. *Lun puteh* (Sar.), *tēnkuyung* (Sanggau).

**50. *Shorea subcylindrica*** SLOOT. Reinwardtia 3 (1956) 331, f. 4; ASHTON, Man. Dipt. Brun. Suppl. (1968) 90, f. 11.

Small to medium-sized tree. Young twigs, bud, stipules outside (subglabrous within) and petiole pale brown frequently somewhat flocculent caducous pubescent. *Twig* c. 2 mm  $\varnothing$  apically, terete or occasionally compressed, straight, minutely fissured; stipule scars short, horizontal. *Bud* c. 3 by 2 mm, ovoid, obtuse. *Stipule* to 10 by 4 mm, lanceolate, subacute, fugaceous. *Leaves* 9–24 by 4–12 cm, relatively large, narrowly elliptic or ovate to lanceolate, coriaceous, lustrous; base cuneate, rarely obtuse; acumen to 1.5 cm long, slender to caudate; nerves 8–11 pairs, prominent beneath, evident above and sunken in shallow furrows as also the midrib, oblique, at  $35^{\circ}$ – $50^{\circ}$ ; midrib prominent on both surfaces; tertiary nerves subreticulate, the scalariform elements



set at 90° to the midrib; *petiole* 9–18 mm long. *Panicle* to 12 cm long, terminal or axillary, terete, lax, ± densely somewhat flocculent buff pubescent, partially caducous; doubly or trebly branched, branchlets bearing to 5 ± second flowers; *bracteoles* c. 1 mm long, minute, deltoid, acute, fugaceous. *Flower bud* to 3 by 1 mm, small, fusiform. *Sepals* ovate, pubescent on parts exposed in bud; 3 outer acute, 2 inner acuminate, thinner towards margin than outer 3. *Petals* cream, narrowly lanceolate, sparsely pubescent on parts exposed in bud, imbricate at base after opening and thus forming a cup, spreading and contorted apically. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the subglobose anthers; appendage to connective as long as or somewhat longer than anther, slender, glabrous, exceeding style apex. *Ovary* ovoid, sericeous; style columnar, stout, somewhat shorter than ovary, sericeous in the basal ½. *Fruit pedicel* c. 1 mm long, short. *Calyx* glabrescent; lobes to 12 by 9 mm, subequal, ovate, acute, relatively thin, hardly saccate. *Nut* to 23 by 16 mm, ellipsoid, acute, densely shortly pale buff pubescent.

Distr. *Malesia*: N.W. Borneo (Sarawak west of the Lupar).

Ecol. Local, on leached clay soils on undulating land in Mixed Dipterocarp forest.

**51. *Shorea obovoidea*** SLOOT. Reinwardtia 3 (1956) 332, f. 5; ASHTON, Man. Dipt. Brun. Suppl. (1968) 88, f. 11.

Small to medium-sized tree. Leaf bud, twig and petiole densely ± unevenly shortly golden-brown pubescent, nervation beneath sparsely so. *Twig* c. 2 mm Ø, terete, becoming pale red-brown, slightly rough; stipule scars short, pale, cuneate, horizontal. *Bud* to 2 by 1 mm, ovoid, acute. *Stipule* unknown. *Leaves* 5–13 by 1.7–4.5 cm, elliptic, coriaceous; base cuneate; acumen to 12 mm long, slender or caudate; nerves 8–10 pairs, slender but prominent beneath, arched, at 45°–55°; tertiary nerves subreticulate; midrib depressed above, prominent beneath; *petiole* 5–8 mm long, slender. *Panicle* to 7 cm long, terminal or axillary, terete, densely ± unevenly shortly golden-brown pubescent; singly branched, branchlets bearing to 5 distichous flowers. *Bud* to 3 by 2 mm, small. *Calyx lobes* ovate, obtuse, pubescent on parts exposed in bud, the outer 3 somewhat longer than the inner 2. *Petals* pale yellow, pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering medially and filiform below the oblong anthers; appendage to connective slightly longer than anther, filiform, villous in the distal ½. *Ovary* narrowly ovoid, sericeous near the apex, slender; style glabrous. *Fruit pedicel* c. 1 mm long, c. 2 mm Ø, short. *Calyx* densely evenly persistently yellow-brown pubescent; lobes to 7 by 4 mm, subequal, short, ovate, acute. *Nut* to 2.5 by 1.7 cm, obovoid to ellipsoid, acute, densely evenly shortly buff pubescent.

Distr. *Malesia*: N.W. Borneo (W. and Central

Sarawak; Kalimantan: Kapuas Valley; Upper Barito).

Ecol. Rare, Mixed Dipterocarp forest on shale hills and undulating land to 500 m.

**52. *Shorea chaiana*** ASHTON, Gard. Bull. Sing. 31 (1978) 42.

Large buttressed tree. Petioles, panicles, perianth outside and ovary persistently ± densely cream-buff puberulent; sepals, twigs and leaf nervation below sparsely ± caducously so; other parts glabrous. *Twigs* c. 1 mm Ø apically, much branched, terete, becoming smooth, dark brown. *Buds* minute. *Leaves* 6–11 by 2–4 cm, elliptic-lanceolate, ± distinctly falcate, subcoriaceous, margin subrevolute; base cuneate or obtuse, subequal; acumen to 15 mm long, slender, caudate; nerves 8–11 pairs, slender but prominent beneath, evident above, arched; tertiary nerves reticulate, distinctly elevated beneath; midrib prominent and terete beneath, evident but appanate to shallowly depressed above; *petiole* 5–8 mm long, short, slender. *Panicle* to 6.5 cm long, terminal or axillary, slender, singly branched; branchlets to 2 cm long. *Flower buds* to 5 by 2 mm, lanceolate. *Sepals* broadly ovate, subacuminate, subequal. *Stamens* 15; filaments expanded and gibbous in the basal half, filiform distally; appendages acicular, c. 2½ times as long as the narrowly ellipsoid 2-locular anthers. *Ovary* ovoid-conical, surmounted by an equally tall columnar puberulent stylopodium and shorter glabrous style. *Mature fruit* unknown; sepals ovate, subequal; ovary ovoid.

Distr. *Malesia*: Northern Borneo (Central and N.E. Sarawak).

Ecol. Local, in Mixed Dipterocarp forest below 1000 m.

Note. The leaves somewhat resemble those of *S. longisperma* ROXB. though the tomentum beneath is more sparse, the base unequal, and besides, the fruit calyx lobes are short and unequal. The leaf base and tomentum also differentiates it from *S. obovoidea* SLOOT.

**53. *Shorea collaris*** SLOOT. Reinwardtia 3 (1956) 329; f. 3; ASHTON, Man. Dipt. Brun. Suppl. (1968) 82, f. 10.

Large buttressed tree. Petiole and bud persistently greyish buff sericeous, young twigs and midrib above caducously so. *Twig* c. 2 mm Ø apically, terete, smooth; stipule scars short, horizontal, obscure. *Bud* to 2 by 2 mm, ovoid, subacute. *Stipule* unknown. *Leaves* 13–23 by 4.3–8.5 cm, oblong-lanceolate, somewhat chartaceous; margin frequently somewhat revolute; base obtuse; acumen to 1 cm long, broad; nerves 13 pairs, slender but elevated beneath, at 45°–60°; tertiary nerves slender, hardly raised, scalariform; midrib appanate above, slender but prominent beneath; *petiole* 19–30 mm long. *Panicle* to 9 cm long, terminal or axillary, terete, densely pale greyish buff pubescent or glabrous; doubly branched, branchlets bearing to 8 ± second flowers; *bracteoles* fugaceous. *Flower bud* to 5 by 3 mm, ellipsoid. *Sepals* ovate,

subacute, densely pubescent on parts exposed in bud; 2 inner sepals narrower at base, thinner at margins, than outer 3. *Petals* lanceolate, densely pubescent on parts exposed in bud or glabrous, strongly contorted. *Stamens* 10, subequal; filaments compressed at base, tapering and filiform below the narrowly ellipsoid anthers; appendage to connective *c.*  $2\frac{1}{2}$  times length of anther, the inner 5 reaching to the style apex, slender, sparsely pubescent in the distal  $\frac{1}{3}$ . *Ovary* and *stylopodium* pyriform, densely pubescent or glabrous, crowned by a short glabrous trifid style. *Fruit pedicel* to 3 mm long, stout. *Calyx* glabrescent; lobes to 10 by 9 mm, subequal, ovate, acute, incrassate, becoming  $\pm$  reflexed distally. *Nut* to 3 by 2 cm, broadly obovoid-ellipsoid, large, apiculate, persistently pale fultous sericeous.

Distr. *Malesia*: Central Borneo (Central Sarawak, Ulu Mahakam, Ulu Kapuas).

Ecol. Locally common, clay rich soils, often near streams, in Mixed Dipterocarp forest on hills below 500 m.

Vern. *Lun kēlabu* (Sar.), *tēlingan* (Kapuas), *tēglam* (Mahakam).

**54. *Shorea angustifolia*** ASHTON, Gard. Bull. Sing. 19 (1962) 277, pl. 12; Man. Dipt. Brun. (1964) 150, f. 14; *ibid.* Suppl. (1968) 81; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 67. — Fig. 89 C–C1.

Small to medium-sized tree. Young twig and stipule sparsely shortly caducous pale brown pubescent; bud, panicle and petiole persistently so. *Twig* to 2 mm  $\varnothing$  apically, straight, terete, superficially cracked, rugose and coming away in small papery flakes. *Leaf bud* 0.5 by 1 mm, small, ovoid, obtuse. *Stipule* to 3 mm long, linear, fugaceous. *Leaves* 8–14 by 2.5–4 cm, deep violet when opening, ovate to lanceolate, coriaceous; base cuneate; acuminate to 1.5 cm long; nerves 8–10 pairs, hardly raised beneath, curved, well spaced, at *c.* 50°–60°; midrib beneath hardly elevated; tertiary nerves densely scalariform; *petiole* 6–8 mm long, finely cracked and drying distinct pale brown to cream-grey. *Panicle* to 10 cm long, terminal or axillary, slender, lax, terete; regularly singly or doubly branched, branchlets to 2 cm long, bearing to 8 distichous flowers; *bracteoles* small, fugaceous. *Flower bud* to 2.5 by 1.5 mm, lanceolate, acute. *Calyx* shortly pubescent outside, glabrous within; lobes ovate, acute, the 2 inner lobes thinner, more constricted at base than 3 outer. *Petals* cream, linear, shortly pubescent on parts exposed in bud, imbricate and cupped at base on opening, twisted and spreading distally. *Stamens* 15, in 3 unequal verticils; filaments broad at base, tapering and filiform distally; anthers oblong; appendage to connective 1–2 times length of anther, ciliate towards apex, as long as style. *Ovary* ovoid, shortly pubescent except at base; stylopodium conical; style short, glabrous; style and stylopodium as long as ovary. *Fruit calyx lobes* to 5 by 5 mm, subequal, broadly ovate, incrassate, obtuse. *Nut* to 8 by 9 mm, obovoid, acute, shortly buff pubescent.

Distr. *Malesia*: Borneo (Sarawak N.E. of Rejang

valley, S.W. Sabah, Tidung, Upper Dyak in S. Borneo).

Ecol. Local, on shale ridges at 500–1200 m (rarely lower).

Vern. *Damar hitam bukit* (Brun.), *sēraya kuning bukit* (Sabah).

**55. *Shorea maxima*** (KING) SYM. Gard. Bull. S. S. 9 (1938) 330; Mal. For. Rec. 16 (1943) 53, f. 29, 32. — *Balanocarpus maximus* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 133; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 110; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5 (1896) 159, t. 192; RIDL, Fl. Mal. Pen. 1 (1922) 248; BURK, J. Mal. Br. R. As. Soc. 1 (1923) 218; HEYNE, Nutt. Pl. ed. 2 (1927) 1128; FOXW. Mal. For. Rec. 3 (1927) 56; *ibid.* 10 (1932) 148; BURK, Dict. (1935) 287. — Fig. 89 A–A2.

Small to medium-sized, often crooked tree. Petiole, stipule, ovary and parts of petals exposed in bud persistently buff puberulent, panicle and calyx outside caducously so. *Leaf bud* to 3 by 2 mm, ovoid, subacute. *Stipule* to 1 cm long, acicular, fugaceous. *Twig* *c.* 3 mm  $\varnothing$ , pale red-brown,  $\pm$  prominently ribbed and conspicuously papery flaky. *Leaves* 8.5–19 by 3.5–7 cm, dark violet when opening, elliptic to lanceolate or rarely oblanceolate, coriaceous; base broadly cuneate to obtuse; apex tapering into an up to 1 cm long short broad acuminate; nerves 7–10 pairs,  $\pm$  ascending, slender but distinctly elevated beneath, obscure above; *petiole* 1–1.5 cm long, *c.* 3 mm  $\varnothing$ , relatively short and stout. *Panicle* to 7 cm long, short, axillary to ramiflorous or occasionally terminal, with a few short branchlets bearing up to 4 second flowers. *Flower buds* to 15 by 4 mm, large, lanceolate. *Sepals* broadly ovate, subequal; outer 3 acute, inner 2 shortly acuminate. *Corolla* pale yellow; *stamens* 10, equal; filaments long, loriate, slender, tapering; anthers subglobose, becoming reflexed; appendages as long as anthers, relatively short. *Ovary* narrowly ovoid, tapering into the prominent glabrous style. *Fruit* sessile; sepals to 15 by 10 mm, subequal, ovate, acute, united at the thickened tuberculate base. *Nut* to 6.5 by 2 cm, very large, fusiform to narrowly obovoid, apiculate.

Distr. *Malesia*: Malaya (Perak and Pahang southwards).

Ecol. Local, on undulating land and hills to 1300 m.

Vern. *Mērantī sēngkawang puteh*, *m. bahru*, *sēngkawang puteh*, *m. kērbau*, *rēsak*, *damar katup*, *sēraya*.

**56. *Shorea tenuiramulosa*** ASHTON, Gard. Bull. Sing. 31 (1978) 42.

Small to medium-sized tree. Panicles caducous greyish puberulent; bracts persistently so, parts of petals exposed in bud and ovary persistently densely so. *Twig* 1–2 mm  $\varnothing$  apically, terete, pale greyish brown, rugulose. *Buds* and *stipules* not seen. *Leaves* 9–24 by 4–11 cm, elliptic to lanceolate, thinly coriaceous drying pale greyish brown; margin undulate, somewhat revolute; base broadly cuneate to obtuse; apex shortly broadly acuminate; nerves 8–9(–11) pairs, arched, at 55°–60°, very slender but distinctly



elevated beneath, slightly so above, as also the laxly reticulate tertiary nerves; midrib prominent on both surfaces; *petioles* 11–20 mm long, drying cream-brown at the ends, otherwise blackish. *Panicles* to 18 cm long, terminal or to 3-axillary or ramiflorous, slender, many flowered; doubly branched, branchlets to 2 cm long; *bracts* to 2 mm long, elliptic, fugaceous. *Flower buds* to 5 by 2 mm. *Sepals* ovate-deltoid, incrassate, subacute, glabrous, subequal. *Stamens* 15, in 3 unequal verticils; filaments dilated at base, tapering and filiform distally; appendages slender, villous distally, c.  $1\frac{1}{2}$  times as long as the narrowly ellipsoid anthers. *Ovary* ovoid, tapering into the somewhat shorter stout columnar style; style villous in the basal  $\frac{1}{2}$ . *Fruit pedicel* to 2 by 2 mm; *sepals* to 6 by 5 mm, equal, ovate, subacuminate, thickened; *nut* to 25 by 8 mm, fusiform-lanceolate.

Distr. *Malesia*: N.E. Borneo (E. Sabah, Sakar I.).

Ecol. Locally frequent on dry rocky ultrabasic ridges near coast.

Note. Clearly allied to *S. angustifolia* ASHTON; the rather broad, chartaceous leaf, curling over irregularly at the margin and with the matte undersurface, and the long and slender, epilose petiole cream coloured only at the distal end, serve to distinguish it.

**57. *Shorea conica*** SLOOT. Reinwardtia 3 (1956) 336, f. 7.

Medium-sized tree. Young parts glabrescent; panicles, parts of petals exposed in bud, calyx and ovary densely persistently pale rufous puberulent. *Twigs* c. 1 mm  $\varnothing$  apically, much branched, terete, smooth, blackish. *Buds* small, ovoid; *stipule* to 2 by 1 mm, ovate, acute, fugaceous. *Leaves* 6–10 by 2–4.5 cm, narrowly ovate, coriaceous; margin subrevolute; base cuneate, subequal; acumen to 2 cm long, slender, prominent; nerves 4–6 pairs, slender but prominent beneath, hardly elevated above as also the midrib, arched, ascending at  $45^{\circ}$ – $50^{\circ}$ ; tertiary nerves densely subreticulate, barely elevated beneath; *petiole* 8–12 mm long, slender. *Panicles* to 8 cm long, terminal or axillary, slender; singly branched, branchlets to 2 cm long; *bracteoles* and *flowers* unknown. *Fruit pedicel* to 3 mm long, stout; *calyx lobes* to 10 by 8 mm, short, subequal, subacuminate, saccate, thickened, appressed to the base of the nut. *Nut* to 32 by 10 mm, narrowly ovoid-lanceolate, tapering, acute.

Distr. *Malesia*: E. Sumatra (Labuan Batu, Indragiri).

Ecol. Local, undulating land near coast.

Vern. *Mēranti pugil*, *m. kunyit*, *m. tēmpalo*, *m. ramba*, *samarupa chēngal*.

**58. *Shorea bakoensis*** ASHTON, Gard. Bull. Sing. 22 (1967) 289, pl. 34; Man. Dipt. Brun. Suppl. (1968) 81, f. 10.

Small tree. All vegetative parts apparently glabrous. *Twig* c. 2 mm  $\varnothing$  apically, smooth; stipule scars short, horizontal. *Bud* and *stipule* unknown. *Leaves* 13–18 by 5–6 cm, narrowly oblong to lanceolate,

coriaceous; base obtuse; acumen to 1 cm long, slender; nerves 9–10 pairs, prominent beneath, at  $55^{\circ}$ – $65^{\circ}$ ; tertiary nerves slender, hardly raised beneath, subscalariform; midrib applanate above, prominent beneath; *petiole* 10–12 mm long, stout. *Flower* and *inflorescence* unknown. *Fruit pedicel* short, obscure. *Calyx lobes* to 4 by 3 mm, subequal, oblong, obtuse, incrassate, saccate, patent, sparsely persistently buff sericeous on the outer surface. *Nut* to 25 by 14 mm, ellipsoid-cylindric, densely evenly persistently buff pubescent; style remnant to 1 mm long.

Distr. *Malesia*: Borneo (W. Sarawak).

Ecol. Rare (one collection); skeletal podsols near coast.

**59. *Shorea xanthophylla*** SYM. Gard. Bull. S. S. 9 (1938) 342, pl. 24; BROWNE, For. Trees Sarawak & Brunei (1955) 164; SLOOT. Reinwardtia 3 (1956) 344; ASHTON, Man. Dipt. Brun. (1964) 160, f. 14; *ibid.* Suppl. (1968) 91; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 78.

Small tree. Young twig and petiole shortly buff caducous pubescent; panicle, stipule (outside only), and leaf bud persistently shortly evenly cream pubescent. *Twig* 2–3 mm  $\varnothing$  apically, straight, stout, terete; petiole scars large, orbicular, swollen; stipule scars short, indistinct. *Bud* to 3 by 1.5 mm, conical. *Stipule* c. 8 by 3 mm, fugaceous, narrowly deltoid, cupped, subacute. *Leaves* 12–25 by 4–7 cm, bright red at first, oblong-lanceolate, thinly coriaceous, slightly bullate; base obtuse or broadly cuneate; acumen to 1 cm long, deltoid; margin sometimes slightly revolute; nerves 9–13 pairs, prominent beneath, at  $40^{\circ}$ – $50^{\circ}$ , curving and continuing parallel with the margin distally, sometimes anastomosing to form an indistinct intramarginal nerve; tertiary nerves remotely scalariform; *petiole* 8–15 mm long, c. 1.5 mm  $\varnothing$ , short. *Panicle* to 10 cm long, terminal or 2-axillary to ramiflorous, angular; somewhat irregularly doubly branched, branchlets to 1.5 cm long, zigzag, bearing to 9 flowers; *bracteoles* minute, fugaceous. *Flower bud* to 4.5 by 1.5 mm, lanceolate, acute. *Calyx* shortly puberulent outside, glabrous within; lobes ovate, the inner 2 lobes thinner, more constricted at the base. *Petals* cream-yellow, linear, shortly pubescent on parts exposed in bud, imbricate and cupped at the base, spreading and twisted distally. *Stamens* 15, in 3 unequal verticils; filaments broad at base, tapering and filiform distally; anthers oblong; appendage to connective 1–2 times length of anther, ciliate towards the apex, reaching the base of the style. *Ovary* ovoid-conical, glabrous at base, shortly pubescent apically, tapering into the stylopodium; style short, glabrous. *Fruit calyx lobes* c. 7 mm long and broad, subequal, broadly ovate, thickened, shortly pale fulvous caducous pubescent outside, glabrous within, not appressed to the nut but prominently saccate. *Nut* c. 2.0 by 1.3 cm, obovoid, subacute, slightly striated longitudinally, densely shortly persistently pale fulvous pubescent.

Distr. *Malesia*: N.E. Borneo (Sabah, Brunei, Sarawak N.E. of Rejang valley).

Ecol. Mixed Dipterocarp forest below 1000 m, on clay soil.

Vern. *Sēraya kuning baru* (Sabah), *mërabubok* (Iban).

**60. *Shorea blumutensis*** Foxw. Mal. For. Rec. 10 (1932) 236, pl. 20; SYM. Mal. For. Rec. 16 (1943) 49, f. 29.

Large tree. Leaf bud, twigs, petioles, midrib below, stipules, panicles, bracteoles, calyx and parts of petals exposed in bud densely tawny puberulent, caducous except on bud, twig apices, petiole, panicle and petals; ovary and nut densely pale buff puberulent. *Leaf bud* to 4 by 2 mm, ovoid, subacute. *Stipules* short, acicular, fugaceous. *Twig* c. 2 mm  $\varnothing$  apically, smooth, terete. *Leaves* 8–17 by 2.8–6.5 cm; elliptic-lanceolate, coriaceous, lustrous beneath, dull above; base cuneate; margin narrowly revolute; acumen to 1 cm long, tapering; nerves 14–16 pairs, very slender, slightly elevated on both surfaces as also the subreticulate tertiary nerves, ascending at c. 50°; midrib prominent beneath, evident and elevated above; *petiole* 1.2–2.2 cm long, c. 2 mm  $\varnothing$ . *Panicle* to 16 cm long, terminal or axillary, lax, singly branched; branchlets to 1 cm long, short, bearing c. 4 second flowers. *Flower bud* to 6 by 3 mm, fusiform; *sepals* ovate, subequal, the 2 inner somewhat the narrower; *stamens* 15, in 3 subequal verticils; filaments compressed, broad at base, tapering and filiform beneath the subglobose anthers; appendages slender, scabrous in the distal  $\frac{1}{2}$ , c. 1½ times length of anthers; *ovary* ovoid, with prominent narrow stylopodium, both densely puberulent; style short, obscurely trifid, glabrous. *Fruit* subsessile; 3 longer *calyx lobes* to 9 by 1.8 cm, spatulate, obtuse, c. 7 mm broad above the to 8 by 10 mm ovate saccate thickened tuberculate base; 2 shorter lobes to 6.5 by 0.7 cm, lorate, similar at base. *Nut* to 3 by 1.3 cm, obovoid, apiculate.

Distr. *Malesia*: Malaya (Johore), N.E. Sumatra (Karimun).

Ecol. Rare, in Lowland Dipterocarp forest below 500 m.

Vern. *Mëranti kelim*.

**61. *Shorea iliasii*** ASHTON, Gard. Bull. Sing. 22 (1967) 291, pl. 36; Man. Dipt. Brun. Suppl. (1968) 85, f. 10.

Medium-sized tree. Young parts greyish sericeous, caducous. *Twig* c. 2 mm  $\varnothing$  apically, terete, sometimes patchily chartaceous flaky; stipule scars short, horizontal. *Bud* c. 2 by 2 mm, conical, subacute. *Leaf* 19–25 by 9–12 cm, oblong-ovate, obtuse but shortly decurrent and subequal at base; acumen to 8 mm long, broad, short; nerves 12–14 pairs, prominent beneath, arched, at 50°–75°; tertiary nerves remotely subscalariform; midrib applanate or slightly elevated above, prominent beneath; *petiole* 22–30 mm long, stout, terete. *Panicle* to 10 cm long, terminal or axillary, terete or somewhat compressed, caducous grey-buff sericeous; singly or doubly branched; bracts and bracteoles unknown. *Buds* to 4 by 2 mm, small, fusiform. *Calyx* densely puberulent on parts exposed

in bud; 3 outer lobes ovate, acute; 2 inner lobes somewhat smaller, narrower at base, shortly fimbriate. *Petals* cream, linear, obtuse, strongly contorted, pubescent on parts exposed in bud. *Stamens* 15, in 2 unequal verticils, the inner 5 somewhat longer than the outer 10; filaments broad at base, tapering and filiform below the subglobose anthers; appendage to connective c. 1½ times length of anther, sericeous in the apical  $\frac{1}{3}$ . *Ovary* narrowly ovoid, pubescent, tapering into the short glabrous style. *Fruit calyx* sparsely greyish sericeous towards the base; 3 longer lobes to 8 by 2.2 cm, spatulate, obtuse to subacute, c. 4 mm broad above the 6 by 5 mm thickened saccate prominently tuberculate base; 2 shorter lobes to 5.5 by 1.2 cm, otherwise as longer lobes. *Nut* to 10 by 8 mm, ovoid, acute, densely persistently greyish sericeous.

Distr. *Malesia*: Borneo (Central Sarawak).

Ecol. Local, clay soils on undulating land and hills below 400 m.

Vern. *Lun siput daun bësar*.

**62. *Shorea faguetioides*** ASHTON, Gard. Bull. Sing. 19 (1962) 287, pl. 17; Man. Dipt. Brun. (1964) 154, f. 14; *ibid.* Suppl. (1968) 83; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 80.

Large buttressed tree. Young twig sometimes shortly buff caducous pubescent; other vegetative parts entirely glabrous. *Twig* 3 mm  $\varnothing$  apically, slightly compressed at first, becoming terete, minutely striated or rugulose. *Bud* 3–4 by 2.5 mm, ovoid, obtuse, compressed. *Stipule* to 18 by 6 mm, narrowly deltoid, saccate, obtuse, less caducous than in most species of *sect. Richetioides*. *Leaves* 12–18 by 5–7 cm, brilliant magenta when opening, narrowly ovate, chartaceous; base broadly cuneate to subcordate, subequal; acumen prominent, c. 2 cm long; nerves 10–15 pairs, slender but prominent, at 60°–70°; tertiary nerves scalariform, slightly oblique to the nerves; *petioles* 2.2–3 cm long, very long, slender. *Panicle* to 15 cm long, terminal or axillary, terete, rugose when dry, lax, sparsely persistently pale greyish brown pubescent; regularly alternately doubly, rarely trebly, branched, branchlets to 2 cm long, bearing to 7 flowers; *bracteoles* small, fugaceous. *Flower bud* to 2.5 by 1.5 mm, small, elliptic, obtuse. *Calyx* densely shortly pubescent outside, glabrous within; lobes ovate, acute, the 2 inner slightly the smaller, thinner, more constricted at base. *Petals* cream, linear, pubescent on parts exposed in bud, imbricate in the basal half forming a broad shallow cup, distally spreading and twisted. *Stamens* 15, in 3 unequal verticils; filaments slender, tapering, basally compressed and slightly gibbous, distally filiform; anthers subglobose; appendage to connective slender, 3 times length of anther, the longest 5 exceeding the style apex, slightly ciliate towards the apex. *Ovary* ovoid, sparsely pubescent; stylopodium shorter than ovary, cylindrical, more densely pubescent; style short, glabrous. *Fruit calyx* puberulent at the base, otherwise glabrescent; 3 longer lobes to 7 by 1.5 cm, chartaceous, broadly spatulate, obtuse, tapering to 4 mm above the to 5 mm broad



prominently tuberculate saccate thickened base; 3 shorter lobes to 5 by 0.7 cm, spatulate, similar at base. *Nut* c. 20 by 6 mm, ellipsoid to obovoid, pale buff pubescent; style remnant c. 3 mm long, slender.

Distr. *Malesia*: Northern Borneo (Ulu Kapuas and Sarawak to S.W. Sabah and W. Kutei).

Ecol. Local, on clay rich soils on hillsides below 700 m.

Vern. *Damar hitam daun nipis* (Brun.), *bēpisang* (Kapuas), *pēnuar* (W. Kutei).

Note. One collection (bb 35287, Ng. Njaban, Ulu Kapuas, W. Borneo) possesses fruit with short subequal sepals; without further collections it is not possible to assess whether it represents more than a single aberrant tree.

**63. *Shorea alutacea* ASHTON**, Gard. Bull. Sing. 22 (1967) 288, pl. 33; Man. Dipt. Brun. Suppl. (1968) 81, f. 10.

Medium-sized tree. Twigs, stipules, leaf buds, petioles and midrib shortly densely persistently buff pubescent, leaf nervation and surface beneath sparsely so. *Twigs* c. 2 mm  $\varnothing$  near the apices, terete; stipule scars c. 1.5 mm long, horizontal, evident. *Bud* c. 2 by 1.5 mm, ovoid, acute, small. *Stipule* to 8 by 3 mm, narrowly deltoid, acute, relatively large. *Leaves* 15–22 by 6–8 cm, ovate to lanceolate, undulate, chartaceous, with cordate base; acumen to 1 cm long, narrow; nerves 14–19 pairs, slender, narrowly depressed above, slender and prominent beneath, at up to 100° at base, 60°–70° distally; tertiary nerves subscalariform, slender, indistinct; midrib depressed above, prominent, terete beneath; *petiole* 6–10 mm long, drying rugose. *Panicle* to 15 cm long, terete, straight, densely shortly pale buff pubescent; singly or doubly branched, branchlets to 2.5 cm long; *bracteoles* to 4 by 3 mm, ovate, acute, densely shortly buff fugaceous pubescent. *Flowers* secund; *buds* to 6 by 3 mm, ellipsoid, relatively large. *Calyx* densely pubescent on parts exposed in bud; sepals broadly ovate, subequal, the inner 2 shortly acuminate, thinner towards the margin and narrower at the base than the acute outer 3. *Petals* lanceolate, pale yellow, pubescent on parts exposed in bud; imbricate at base after opening forming a cup; spreading and twisted distally. *Stamens* 15, in 3 unequal verticils the appendages of the inner 5 exceeding the style apex; filaments broad and compressed at base, tapering and filiform distally; anthers broadly oblong; appendage to connective slender, 3–4 times as long as anther, glabrous. *Ovary* and *stylopodium* pyriform, densely pubescent, tapering into a glabrous columnar style equal in length to the stylopodium. *Fruit pedicel* and *calyx* shortly sparsely caducous pubescent. *Pedicel* c. 1 mm long, short. 3 longer calyx lobes to 8 by 1.8 cm, spatulate, c. 4 mm broad above the to 7 by 7 mm ovate saccate thickened base; 2 shorter lobes to 6 by 1.2 cm, otherwise similar to longer lobes. *Nut* to 2.2 by 1 cm, narrowly ovoid, shortly apiculate, densely shortly evenly buff pubescent.

Distr. *Malesia*: Borneo (W. Sarawak).

Ecol. Rare, lower slopes of granodiorite mountains.

**64. *Shorea longisperma* ROXB.** [Hort. Beng. (1814) 93, *nomen*] Fl. Ind. ed. Carey 2 (1832) 618; DC. Prod. 16, 2 (1868) 632; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 103; RIDL. Fl. Mal. Pen. 1 (1922) 143; ASHTON, Gard. Bull. Sing. 31 (1978) 43. — *Parashorea longisperma* KURZ, J. R. As. Soc. Beng. Sc. 39, 2 (1870) 66; DYER, Fl. Br. Ind. 1 (1874) 441; SLOOT. Bull. Jard. Bot. Btzig III, 8 (1927) 571; FOXW. Mal. For. Rec. 10 (1932) 226. — *S. resina-negra* FOXW. Mal. For. Rec. 10 (1932) 205, pl. 16; BURK. Dict. (1935) 2021; SYM. Mal. For. Rec. 16 (1943) 56, f. 29, 35; ASHTON, Man. Dipt. Brun. Suppl. (1968) 89, f. 11, pl. 18 (habit, bole, damar).

Very large, prominently buttressed tree. Leaf bud and stipule persistently unevenly shortly fulvous pubescent, twig caducously so. Leaf beneath and petiole persistently shortly subscabrid pale grey-green pubescent. *Twig* 1–2 mm  $\varnothing$  apically, slender, terete, becoming smooth; stipule scar small, horizontal to descending, frequently obscure. *Bud* to 3 by 2 mm, ovoid, acute. *Stipule* to 5 by 2 mm, ovate to lorate, acute, caducous. *Leaves* 7–12 by 2.3–6 cm, elliptic to ovate, somewhat chartaceous, pale mauve when fresh; base cuneate to obtuse, acumen to 1.5 cm, long, slender; nerves 10–13 pairs, at 45°–55°, slender, raised beneath; tertiary nerves subscalariform; midrib appanate to slightly depressed above, prominent beneath; *petiole* 10–15 mm long. *Panicle* to 7 cm long, terete or ribbed, slender, densely persistently pale fulvous scabrid pubescent; shortly singly branched, branchlets ascending, bearing to 4 flowers. *Buds* to 9 by 3 mm, lanceolate. *Sepals* broadly ovate, acute, densely sericeous on parts exposed in bud, the inner 2 fimbriate, somewhat shorter than the outer 3. *Petals* pale yellow, narrowly lanceolate, strongly contorted, sericeous on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments broad and compressed at base, tapering to the large broadly ellipsoid anthers; appendage to connective slender, c. 2 times length of anther at anthesis. *Ovary* and *stylopodium* pyriform, shortly densely pubescent; style slender, columnar, glabrous, as long as ovary and stylopodium. *Fruit* sessile. *Calyx* sparsely pubescent; 3 longer lobes to 9 by 1.5 cm, spatulate, obtuse, c. 3 mm broad above the to 6 by 4 mm elliptic saccate tuberculate thickened base; 2 shorter lobes to 7 by 0.4 cm, linear, obtuse, similar at base. *Nut* to 2.3 by 1.2 cm, ellipsoid, acute, shortly evenly densely buff pubescent.

Distr. *Malesia*: Malaya (except seasonal areas), E. Sumatra (Labuhan Batu), Borneo (Central and N. Sarawak, S.E. and S. Borneo).

Ecol. Scattered on fertile clay rich soils in Mixed Dipterocarp forest, especially on igneous and volcanic rocks on undulating land and sheltered inland mountain slopes to 1400 m.

Vern. *Mēranti damar hitam*, *kala*, *katup*, *mērawan*, *sēnggai* (Mal.), *lun mēranti* (Sar.), *mērsiput*, *mērak-unyit*, *kērambukuh*, *mēmukuh*, *awang sih* (S.E. Borneo).

65. *Shorea acuminatissima* SYM. Gard. Bull. S. S. 9 (1938) 340, pl. 23; BROWNE, For. Trees Sarawak & Brunei (1955) 162; ASHTON, Man. Dipt. Brun. (1964) 149, f. 14; *ibid.* Suppl. (1968) 81; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 65, pl. 2 (habit), f. 8.

Very tall buttressed tree with dark brown square-section fissured bark. Twig, panicle, petiole, bud, stipule and nervation beneath  $\pm$  persistently scabrid rust pubescent. *Twig* c. 1.5 mm  $\varnothing$  apically, slender, much branched, terete, becoming smooth. *Bud* to 1.2 by 1 mm, globose to ellipsoid, small. *Stipule* c. 6 by 3.5 mm, oblong-falcate, base obtuse or subcordate; caducous, more persistent in young trees. *Leaves* 7–10 by 3–4 cm, ovate, sometimes cream to brown lepidote beneath; base obtuse; acumen c. 7 mm long; short, acute; margin revolute; nerves 9–12 pairs, prominent beneath, at c. 40°–50°; tertiary nerves dense, scalariform, distinct; midrib prominent beneath, depressed above; *petiole* 1–1.5 cm long, slender. *Panicle* to 8 cm long, terminal or axillary, terete, singly branched; branchlets to 2 cm long, bearing to 6 secund flowers; *bracteoles* to 2 by 2 mm, broadly oblong, obtuse, puberulent. *Flower bud* to 5 by 3 mm, ellipsoid, subacute. *Calyx* densely pubescent outside, glabrous within; lobes broadly ovate, subequal, obtuse; inner 2 lobes thinner towards margin, narrower at base, than outer 3. *Petals* shortly pubescent on parts exposed in bud, imbricate at base after opening forming a cup, spreading and contorted distally. *Stamens* 15, of 2 lengths the longest 5 exceeding the ovary; filaments broad, compressed, tapering, somewhat gibbous; anthers broadly oblong; appendage to connective longer than anthers, slender, puberulent towards apex. *Ovary* and *stylopodium* narrowly ovoid, with a band of short hairs towards the apex; style as long as ovary and *stylopodium*, slender, glabrous. *Fruit* subsessile, with prominent obconical receptacle; *calyx* puberulent or glabrescent; 3 longer lobes to 6 by 1.3 cm, spatulate, obtuse, to 3 mm broad above the to 4 by 4 mm somewhat tuberculate thickened base; 2 shorter lobes to 4.5 by 0.8 cm, otherwise similar. *Nut* to 2 by 0.7 cm, narrowly ovoid, densely pale rufous pubescent.

Distr. *Malesia*: N.E. Borneo (from Baram valley N.E. to Sabah).

Ecol. Local, Mixed Dipterocarp forest on sandy clay soils on hills below 500 m, usually near the coast.

Vern. *Sēraya kuning runching* (Sabah), *damar hitam runching* (Brun.), *barun runching* (Sar.).

66. *Shorea gibbosa* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 99; RIDL, J. Str. Br. R. As. Soc. 54 (1909) 23; BURK. *ibid.* 76 (1917) 165, fig.; RIDL, Fl. Mal. Pen. 1 (1922) 289; Foxw. Mal. For. Rec. 10 (1932) 208; SYM. Gard. Bull. S. S. 7 (1933) 143, pl. 42; Mal. For. Rec. 16 (1943) 51, f. 29; BROWNE, For. Trees Sarawak & Brunei (1955) 162; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 71, pl. 4a, f. 9; ASHTON, Man. Dipt. Brun. Suppl. (1968) 83, f. 10. — *Hopea grisea* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 63; MERR. En. Born. (1921) 404.

Very tall, buttressed tree. Twig, bud, petiole and stipule persistently shortly evenly pale rufous pubescent, leaf nervation beneath sparsely so, glabrescent. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched, at first frequently rugulose. *Stipules* to 3 by 1 mm, narrowly elliptic, acute, fugaceous. *Leaves* pink when opening, 5–13 by 2–6 cm, ovate, chartaceous, undulate; base broadly cuneate to obtuse; acumen to 1.5 cm long; nerves 7–9 pairs, slender but prominent beneath, at 50°–65°; tertiary nerves subreticulate; midrib somewhat depressed above, prominent beneath; *petiole* 8–12(–16) mm long, short. *Panicle* to 10 cm long, terminal or axillary, terete, persistently buff to pale rufous pubescent; singly branched, branchlets to 2 cm long, bearing to 6  $\pm$  distichous flowers; *bracteoles* to 2 by 1 mm, oblong, obtuse, shortly pubescent, fugaceous. *Bud* to 5 by 3 mm, lanceolate. *Sepals* ovate, shortly densely pubescent on parts exposed in bud; outer 3 acute, inner 2 shortly acuminate, relatively broader, shorter, thinner at the margin. *Petals* cream with a pink base, narrowly oblong, strongly contorted, sericeous on parts exposed in bud. *Stamens* 15, in 3 unequal verticils, the longest reaching the style apex; filaments compressed and gibbous at base, tapering and filiform below the small broadly ellipsoid anthers; appendage to connective somewhat longer than anther, slender, glabrous. *Ovary* ovoid, densely pubescent; style columnar, pubescent in the basal  $\frac{1}{2}$ , otherwise glabrous. *Fruit pedicel* to 2 mm long, slender. *Calyx* shortly sparsely pubescent; 3 longer lobes to 9 by 2 cm, spatulate, obtuse, c. 4 mm broad above the to 10 by 6 mm ovate saccate thickened tuberculate base; 2 shorter lobes to 6 by 0.5 cm, narrowly spatulate, acute, similar at base. *Nut* to 1.8 by 1.2 cm, narrowly ellipsoid, densely buff pubescent, acute.

Distr. *Malesia*: Malaya (Johore), Singapore, S.E. Sumatra (Palembang, Lampong), Borneo.

Ecol. Locally common on deep fertile clay-rich soils, on undulating land and low hills below 650 m.

Vern. *Damar hitam gajah* (Mal.), *lun gajah* (Sar.), *sēraya kuning gajah* (Sab.), *madilan*, *mērakunyt*, *damar tēnkuyung*, *d. kētuyung*, *awang pakit*, *kelepeh*, *kēnuar*, *mēranti kuning*, *dahu mentola*, *bangkirai*, *lampong kuning* (Indon. Borneo), *damar buah*, *d. b. kuning* (Sumatra).

Note. A variable species distinguished by the sparsely pubescent leaf nervation and leaves crinkling on drying. Collections from East Borneo typically bear lanceolate leaves drying pale grey-green beneath, and a denser fulvous tomentum on perianth and panicle.

67. *Shorea hopeifolia* (HEIM) SYM. Gard. Bull. S. S. 8 (1933) 150, pl. 46; *ibid.* 8 (1934) 36; Mal. For. Rec. 16 (1943) 52, f. 29; BROWNE, For. Trees Sarawak & Brunei (1955) 163; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 72; ASHTON, Man. Dipt. Brun. Suppl. (1968) 84, f. 10; Gard. Bull. Sing. 31 (1978) 43. — *Cotylelobium hopeifolium* HEIM, Bull. Mens. Soc. Linn. Paris 1 (1891) 971; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 95;



BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 153. — *S. ridleyana* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 115, *p.p.*; RIDL, Fl. Mal. Pen. 1 (1922) 226, *p.p.*; FOXW. Mal. For. Rec. 2 (1927) 353; *ibid.* 10 (1932) 209, *p.p.*; SLOOT, ex MERR. Pl. Elm. Born. (1929) 204. — *Hopea heimiana* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 63; MERR. En. Born. (1921) 402. — *Hopea albescens* RIDL, J. Str. Br. R. As. Soc. 73 (1916) 142; Fl. Mal. Pen. 1 (1922) 236. — *S. kaluntii* MERR. Philip. J. Sc. 26 (1925) 475; DESCH, Mal. For. Rec. 12 (1936) 35, 39; FOXW. Philip. J. Sc. 67 (1938) 307. — *Hopea hopeifolia* SLOOT, Bull. Jard. Bot. Btzg III, 10 (1929) 396.

Very tall buttressed tree. Vegetative parts glabrous. *Twigs* c. 1 mm  $\varnothing$  apically, terete, slender, much branched, minutely rugulose; stipule scars short, horizontal, obscure. *Bud* c. 1 by 1 mm, small, ovoid, acute, glabrous. *Stipule* to 5 by 2 mm, lanceolate, acute, fugaceous. *Leaves* 3.5–8 by 2–4 cm, small, ovate, somewhat chartaceous and undulate; base broadly cuneate, usually with prominent pore-like glabrous domatia on either side of the base of the midrib; acumen to 1 cm long, prominent; nerves 9–11 pairs, slender, hardly raised beneath, arched, at 55°–65°, with distinct secondary nerves; tertiary nerves reticulate; midrib applanate above, prominent beneath, drying dark red or black; *petiole* 8–10 mm long, slender, geniculate. *Panicle* to 5 cm long, terminal or axillary, terete, densely persistently pale buff pubescent; singly branched, branchlets bearing to 9 distichous flowers; *bracteoles* to 2 by 2 mm, elliptic, obtuse, puberulent outside, glabrous within, caducous. *Bud* to 5 by 2 mm, small, lanceolate. *Sepals* pubescent on parts exposed in bud, ovate, acute; the inner 2 relatively broader and thinner at the margins than the outer 3. *Petals* pale yellow, narrowly lanceolate, densely pubescent on parts exposed in bud, strongly contorted. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the ellipsoid anthers; appendage to connective slightly shorter than anther, glabrous. *Ovary* ovoid, pubescent, surmounted by a columnar tapering style equal in length and pubescent in the basal  $\frac{1}{2}$ . *Fruit* pedicel and base of calyx sparsely buff pubescent, calyx elsewhere glabrescent. *Pedicel* c. 3 mm long. 3 longer *calyx lobes* to 7 by 1.5 cm, spatulate, obtuse, c. 4 mm broad above the to 5 by 5 mm deltoid thickened saccate tuberculate base; 2 shorter lobes to 4 by 0.7 cm, spatulate, acute, similar at base. *Nut* to 2.7 by 1.2 cm, ellipsoid, shortly apiculate, densely shortly evenly buff pubescent.

Distr. *Malaysia*: Malaya (seasonal area excepted), Sumatra (Palembang, Lampong, and E. Coast Res.: Tapanuli to Pariaman in west), Borneo, Philippines (Mindanao).

Ecol. Scattered on fertile clay rich soil on undulating land and hills below 600 m, often in moist places.

Vern. *Damar siput jantan, sēraya, s. labu* (Mal.), *suranti limau manis, aruing, mēranti kuning, damar buah* (Sumatra), *sēraya kuning jantan* (Sabah), *lun siput jantan* (Sar.), *tali makas* (Dus.), *sēlangan kacha,*

*mērakunyt, bērēmbuku, lampong bēmbēring, damar b., utuhutap* (Indon. Borneo).

Note. Some specimens from S.E. Sabah and N.E. Kalimantan suggest that hybridization with *S. gibbosa* may sometimes occur there.

**68. *Shorea kudatensis*** WOOD ex MEIJER, Act. Bot. Neerl. 12 (1963) 346, pl. 12; Sabah For. Rec. 5 (1964) 74, pl. 5 (bark).

Medium-sized buttressed tree. Panicle, parts of petals exposed in bud and ovary persistently cream puberulent; calyx at first densely so, becoming sparse; twig caducously so. *Twigs* c. 3 mm  $\varnothing$ , rather stout, terete,  $\pm$  rugulose. *Bud* small, ovoid, obtuse; *stipules* fugaceous, not seen. *Leaves* 8–15 by 5–9 cm, ovate, coriaceous, lustrous above; base  $\pm$  obtuse, subequal, shortly decurrent; apex shortly broadly acuminate; nerves 7–9 pairs, very slender but distinctly elevated on both surfaces as also the midrib, strongly arched, at 45°–55°; tertiary nerves subreticulate, distinctly elevated beneath, evident above; *petiole* 17–22 mm long, rather stout. *Panicle* to 14 cm long, terminal or axillary, many-flowered; doubly branched, branchlets to 3 cm long. *Flower buds* c. 3 by 2 mm, small, ellipsoid. *Sepals* broadly ovoid, the outer 3 subacuminate, the inner 2 acute. *Petals* cream. *Stamens* 15, unequal; filaments broadly compressed at base, tapering and filiform beneath the oblong anthers; appendages slender but short,  $\pm$  equal in length to anthers, scarious towards apices. *Ovary* ovoid, tapering into the short glabrous style. *Fruit* subsessile; 2 longer *calyx lobes* to 6 by 1 cm, spatulate, obtuse, c. 3 mm broad above the c. 4 by 3 mm narrowly ovate thickened saccate tuberculate base; 2 shorter lobes to 43 by 5 mm, subacute, otherwise similar. *Nut* to 20 by 8 mm, narrowly ovoid.

Distr. *Malaysia*: N.E. Borneo (Kudat to Kilias and Sandakan).

Ecol. Locally common on dry hills near coast.

Vern. *Sēraya kuning kudat*.

**69. *Shorea cuspidata*** ASHTON, Gard. Bull. Sing. 22 (1967) 290, pl. 35, 350 (phot. habit); Man. Dipt. Brun. Suppl. (1968) 82, f. 10, pl. 14 (stem-base).

Medium-sized tree. Leaf bud and stipule shortly buff pubescent, young twigs caducously so; leaf glabrous. *Twig* c. 1 mm  $\varnothing$  towards apex, slender, terete, minutely striated. *Bud* c. 1 mm long, small, ovoid. *Leaves* 5–9 by 2–6 cm, small, broadly ovate, subcoriaceous, with broadly cuneate base; acumen to 1.5 cm long, subcaudate; nerves 5–7 pairs, slender, hardly raised beneath, at 40°–50°; tertiary nerves reticulate, obscure; midrib slender, applanate or slightly raised above, prominent beneath; *petiole* 7–11 mm long, slender. *Panicle* to 9 cm long, terminal or axillary, slender, terete, densely evenly shortly buff pubescent; singly branched, branchlets to 1.5 cm long. *Flowers* secund; *buds* to 3 by 2 mm, small, ellipsoid. *Calyx* pubescent on parts exposed in bud; sepals broadly ovate, small, subequal, acute, the inner 2 broader and thinner at the margin than the outer 3.

*Petals* pale lime-yellow, lanceolate, densely pubescent on parts exposed in bud, connate at base, strongly contorted. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering and filiform below the ellipsoid anther; appendage to connective c.  $1\frac{1}{2}$  times length of anther, slender, pubescent in the distal  $\frac{1}{2}$ , almost reaching to style apex at anthesis. *Ovary* and *stylopodium* pyriform, sericeous, crowned with a short columnar glabrous style. *Fruit pedicel* and *calyx* shortly sparsely buff pubescent. *Pedicel* c. 1 mm long, short. 3 longer *calyx lobes* to 5 by 1.5 cm, broadly spatulate, obtuse, c. 3 mm broad above the to 5 mm broad saccate thickened base; 2 shorter lobes to 4 by 1 cm, otherwise as in longer lobes. *Nut* to 2.5 by 1.5 cm, obovoid, mucronate, densely shortly evenly buff pubescent.

Distr. *Malesia*: Borneo (Sarawak w. of the Lupar).

Ecol. Locally common on undulating land and low hills in Mixed Dipterocarp forest, to 500 m.

Vern. *Lun runching padi*.

**70. *Shorea mujongensis*** ASHTON, Gard. Bull. Sing. 22 (1967) 292, pl. 38, 351 (phot. habit); Man. Dipt. Brun. Suppl. (1968) 87, f. 11, pl. 17 (stem-base).

Tall buttressed tree. Young twig, bud and petiole shortly buff pubescent, glabrescent. *Twig* c. 2 mm  $\varnothing$  apically, terete, rugulose; *stipule* unknown. *Leaves* 6–14 by 2.5–5.5 cm, ovate or elliptic, margin  $\pm$  revolute, base obtuse to cuneate; acumens to 8 mm long; nerves 8–13 pairs, slender but prominent beneath, curved, at c. 50°; tertiary nerves scalariform, unraised, narrowly channelled, beneath; midrib appanate above, prominently terete beneath; *petiole* 10–16 mm long, terete. *Flowers* unknown. *Panicle* to 6 cm long, singly branched, terete, rugulose, shortly evenly buff puberulent. *Flower bud* to 6 by 4 mm, fusiform. *Perianth* puberulent on parts exposed in bud; *sepals* ovate, subacute. *Stamens* 15, in 3 unequal verticils; filaments broad at base, tapering; anthers ellipsoid; appendages same length as anthers, slender, glabrous. *Ovary* and *stylopodium* pyriform, puberulent except at apex, surmounted by a short glabrous style. *Fruit pedicel* to 2 mm long, puberulent. *Fruit calyx* sparsely puberulent to glabrescent; 3 longer lobes to 7 by 1.5 cm, spatulate, obtuse, 4 mm wide above the 6 by 5 mm tuberculate incrassate base; 2 shorter lobes to 4.5 by 0.7 cm, otherwise similar. *Nut* to 2.2 by 0.7 cm, narrowly ovoid, densely shortly pale buff pubescent.

Distr. *Malesia*: Borneo (Central Sarawak, E. Sabah).

Ecol. Local, on fertile soils overlying or influenced by basic volcanic rocks, to 1100 m.

Note. Close to *S. gibbosa* but the minutely channelled, hardly or unraised tertiary nerves beneath (sapling excluded), and the glabrous subcoriaceous appanate leaves serve to distinguish it. Collections from Sarawak have larger more prominently revolute ovate leaves.

**71. *Shorea faguetiana*** HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 975; BRANDIS, J. Linn. Soc. Bot. 31

(1895) 95, *p.p.*; MERR. En. Born. (1921) 414; SYM. Gard Bull. S. S. 7 (1933) 148, pl. 45; *ibid.* 10 (1939) 381; Mal. For. Rec. 16 (1943) 50, f. 29, 31; BROWNE, For. Trees Sarawak & Brunei (1955) 162; ASHTON, Man. Dipt. Brun. (1964) 152, f. 14; *ibid.* Suppl. (1968) 83; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 69, pl. 3, 4b. — *S. ridleyana* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 115, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 99, *p.p.*; BRÜHL & KING, Ann. R. Bot. Gard, Calc. 5, 2 (1896) 153, t. 185, *p.p.*; RIDL. Fl. Mal. Pen. 1 (1922) 226, *p.p.*; FOXW. Mal. For. Rec. 3 (1927) 38, *p.p.*; *ibid.* 10 (1932) 209, *p.p.*; BURK. Dict. (1935) 2021. — *S. dryobalanoides* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 95, *nomen in syn.*

Medium-sized or large buttressed tree. Bud, stipule outside, panicle and young twig pale greyish pubescent; fresh young leaves sparsely fugaceous pubescent beneath. *Twig* slender, dotted with large pale lenticels, with a minutely wrinkled striated papery flaked surface. *Bud* c. 2 by 1.5 mm, small, ovoid to conical. *Stipule* to 4 by 1.5 cm, hastate, pubescent. *Leaves* 7–12 by 3–5 cm, elliptic to oblong-lanceolate or ovate, coriaceous; base obtuse or cuneate, symmetrical or subequal; acumens to 1 cm long; margin generally slightly revolute; nerves 9–12 pairs, slender but distinctly elevated beneath, at c. 30°–50°; tertiary nerves scalariform, rather dense, oblique to the nerves; *petiole* 1–1.5 cm long, fairly stout. *Panicle* to 20 cm long, terminal or axillary, terete or angular, lax; regularly doubly or trebly branched, branchlets to 1 cm long, bearing to 8 flowers; *bracteoles* small, fugaceous. *Flower bud* to 3 mm long, small, elliptic to subglobose. *Calyx* shortly pubescent outside, glabrous within; lobes ovate, subequal, subacute, 2 inner lobes thinner towards margin, more constricted basally. *Petals* cream, linear, the basal half imbricate, forming a cup on opening, spreading and strongly twisted distally. *Stamens* 15, in 3 unequal verticils; filaments broad at base, tapering rapidly and filiform distally; anthers subglobose; appendage to connective as long as anthers and reaching almost to the style apex, sparsely ciliate towards the apex. *Ovary* subglobose, shortly pubescent; *stylopodium* as long as ovary, pubescent; style short, glabrous. *Fruit* sparsely pubescent; 3 longer *calyx lobes* to 6 by 1.2 cm, thinly coriaceous, spatulate, obtuse, 2.5 mm broad above the c. 3.5 mm broad thickened tuberculate base; 2 shorter lobes c. 4.5 cm long, narrower, with a narrower base. *Nut* to 15 by 5 mm, narrowly ellipsoid to subobovoid, shortly buff pubescent; style remnant short, acute.

Distr. Thailand (Pattani) and in *Malesia*: Malaya (non-seasonal parts), Borneo (Sarawak, Sabah, S.E. Borneo to Muara Tewe).

Ecol. Well drained clay soils on low hills and particularly ridge tops at 150–1000 m (mainly to 700 m).

Vern. *Damar siput*, *kala*, *k. jantan*, *sĕraya*, *s. kitan*, *bam*, *rinchong*. (Mal.), *lun siput* (Sar.), *sĕraya kuning siput* (Sabah), *katukan* (Kinababangan), *selangan kacha*, *sĕngangan kacha*, *pangkang puteh* (Tidung, Berau).



## 5. Section Anthoshorea

HEIM, Rech. Dipt. (1892) 41; BRANDIS, J. Linn. Soc. Bot. (1895) 84, *p.p.*; SYM. Mal. For. Rec. 16 (1943) 27, f. 17 (map); ASHTON, Gard. Bull. Sing. 20 (1963) 268; Man. Dipt. Brun. (1964) 116. — *Shorea sect. Hopeoides* HEIM, Rech. Dipt. (1892) 43. — *Anthoshorea* PIERRE *ex* HEIM, *l.c.* in *syn.* — *Parahopea* HEIM, *l.c.* 66. — *Shorea Meranti Pa'ang* group SYM. Mal. For. Rec. 16 (1943) 27. — *Shorea subg. Anthoshorea* (HEIM) MEIJER, Act. Bot. Neerl. 12 (1963) 322. — **Fig. 91B–C, 92.**

Flowers usually large. *Petals* white, sometimes with a median pink suffusion, broadly elliptic or ovate-lanceolate, contorted imbricate at base at anthesis forming a rather large broad goblet enclosing the anthers, loosely connate on falling. *Stamens* 15–30 in 3 verticils, or  $\infty$ ; filaments broad at base, gradually tapering; anthers with 4 pollen sacs, narrowly oblong to linear; appendage to connective unreflexed, prominent, usually at least half as long as anther, stout or slender, scabrous or glabrous. *Ovary* pubescent or glabrous, without distinct stylopodium; style longer than ovary,  $\pm$  distinctly trifid distally. *Stipules* caducous, often large; *bracts* and *bracteoles* frequently large, somewhat persistent. *Leaf* with scalariform tertiary nerves; midrib obscure, depressed, above. Medium sized or more usually large stoutly buttressed trees. *Bark* surface with irregular section fissures, frequently short and anastomosing; inner edge of outer bark ill-defined; outer surface rotting off, rarely flaking regularly; periderms undulate, incomplete or absent; inner bark simply laminate. *Wood* cream or yellow, rarely red (*S. montigena*) with ray cells bearing silica deposits; vessels arranged in a reticulum as seen in transverse section, solitary or occasionally in pairs.

Distr. Ceylon and Peninsular India to Indochina and through *Malesia* to the Moluccas.

Ecol. Semi-evergreen and evergreen lowland forests. Several species (*S. roxburghii*, *S. hypochra*, *S. polita*, *S. assamica*, *S. retinodes*) can occur in gregarious stands, especially in seasonal forests.

Vern. *White mēranti*, *mēranti pa'ang* (Mal.), *raruk* (Iban), *mēlapi* (Sabah).

Note. *S. bracteolata* appears to be pollinated by thrips (APPANAH) whereas *S. roxburghii* has been found to be visited by bees in Thailand (SMITINAND, pers. comm.). Most species are rather uniform and well defined, the notable exception being the widespread *S. assamica* and its siblings *S. agamii* of Borneo, which has two subspecies, one of which can be triploid, and *S. resinosa* in which abundant apoximis through adventive polyembryony is well known (FOXWORTHY, KAUR).

**72. *Shorea dealbata*** Foxw. Mal. For. Rec. 10 (1932) 192, pl. 14; BURK. Dict. (1935) 2010; SYM. Mal. For. Rec. 16 (1943) 35, f. 19; ASHTON, Man. Dipt. Brun. Suppl. (1968) 93, f. 12. — *S. aff. hypochra* (non HANCE) BROWNE, For. Trees Sarawak & Brunei (1955) 519.

Medium-sized, hardly buttressed tree. Young twigs, buds, stipules outside and petiole densely shortly evenly dark fulvous pubescent, nervation beneath fugaceously so; leaf beneath pale pink-brown lepidote. *Twig*, c. 4 by 2 mm  $\varnothing$  towards apex, compressed, smooth to finely rugulose; *stipule scars* c. 2 mm long on young twigs, subhorizontal, prominent with a prominent rib descending the twig from their ends. *Bud* to 6 by 4 mm, ovoid, conical, subacute. *Stipule* to 20 by 5 mm, elliptic-oblong, subacute. *Leaves* alternate, 8–16 by 4–7.5 cm, ovate to elliptic,

coriaceous; base obtuse, rarely cuneate; acumen to 1 cm long, narrow; nerves (11–)20–24 pairs, obscure and slightly depressed above, slender and hardly elevated beneath, at up to 75° towards the base, 40°–60° towards the apex; tertiary nerves dense, parallel, slender, obscure; midrib obscure, depressed above, prominent, subacute beneath; *petiole* 1.5–2.5 cm long, stout, rugose especially distally when dry. *Panicle* to 8 cm long, terete or angular, densely pale fulvous hirsute, axillary or terminal; unbranched or singly branched, branchlets to 1.5 cm long; *bracteoles* fugaceous, unknown. *Flowers* distichous; *bud* to 12 by 5 mm, lanceolate. *Calyx* densely pale fulvous hirsute outside, glabrous within; 3 outer lobes narrowly deltoid, subacute, 2 inner lobes shorter, ovate, cuspidate. *Petals* oblong-lanceolate, white tinged with pink at base, densely pubescent on parts exposed in bud.

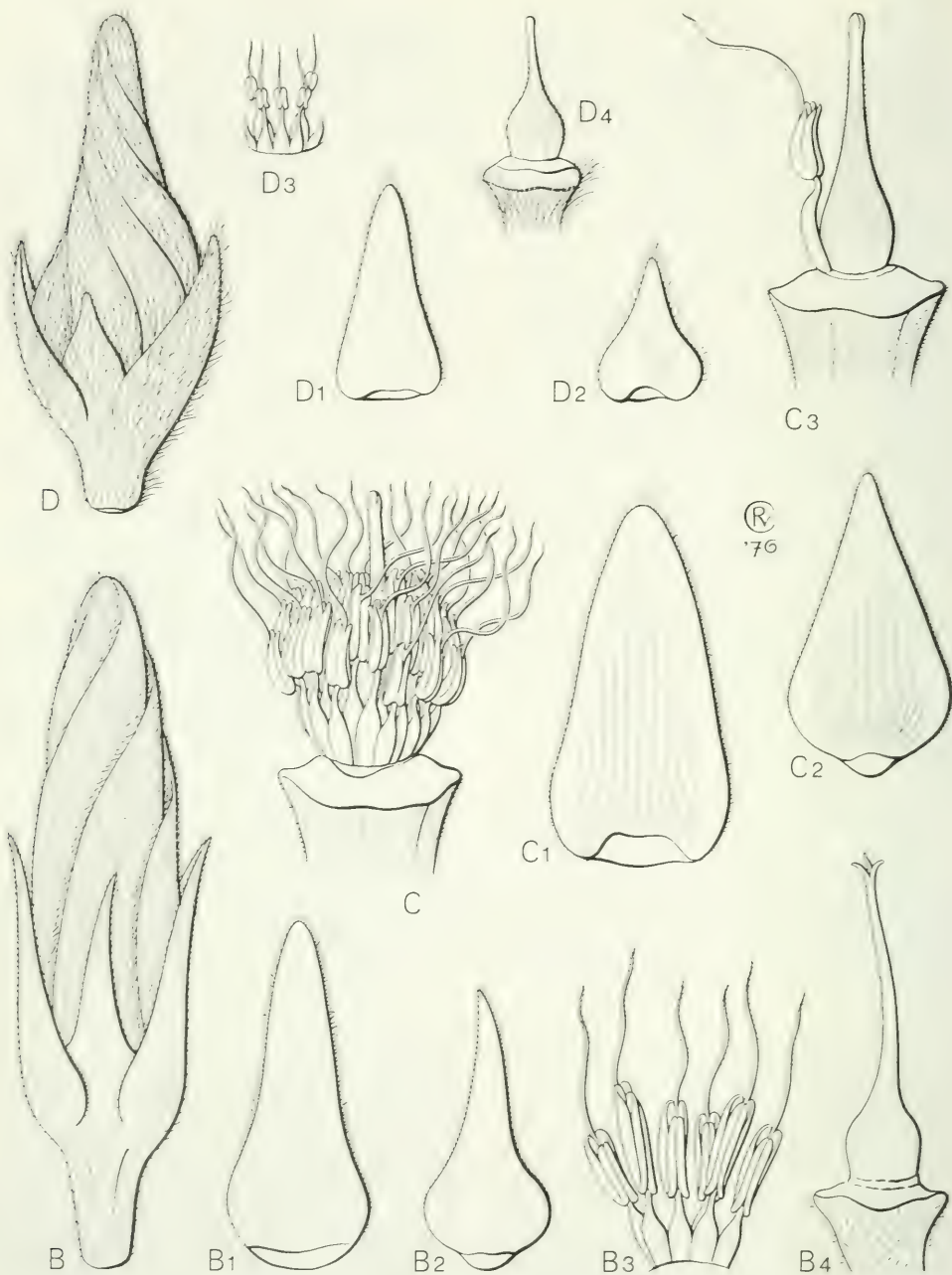


Fig. 91. Flower details in *Shorea* sect. *Anthoshorea* HEIM (B and C) and sect. *Brachypterae* HEIM subsect. *Brachypterae* (D). Sepals drawn from inside. — *S. roxburghii* G. DON. B. Bud. B1. outer sepal. B2. inner sepal. B3. stamens from inside, B4. pistil, all  $\times 10$ . — *S. henryana* PIERRE. C. Stamens and pistil, C1. outer sepal, C2. inner sepal. C3. one stamen in lateral view and pistil, all  $\times 6$ . — *S. balangeran* (KORTH.) BURCK. D. Bud, D1. outer sepal. D2. inner sepal. D3. stamens from outside. D4. pistil, all  $\times 10$  (B KERR 8392, C KERR 17713, D Cult. Hort. Bog. VIII-D-6).



*Stamens* 17, unequal; filaments lorate, somewhat tapering,  $\pm$  as long as anthers; anthers narrowly oblong; appendage to connective filiform, stout at base, rapidly tapering to a very slender apex, 3 times length of anther, the inner 5 reaching the style apex, sericeous in the distal  $\frac{1}{2}$ . *Ovary* ovoid, sparsely sericeous; style filiform, trifurcate apically, sericeous in the basal  $\frac{1}{2}$ . *Fruit pedicel* to 5 mm long, slender. 3 longer *calyx lobes* to 9 by 1.3 cm, narrowly spatulate, subacute, 3.7 mm broad above the *c.* 8 by 8 mm subauriculate thickened base; 2 shorter lobes to 6.5 by 0.4 cm, lorate, acute, similar but narrower at base. *Nut* to 18 by 8 mm, narrowly ovoid, densely pale fulvous pubescent; style remnant to 3 mm long.

Distr. *Malesia*: Malaya (Pahang), Sumatra (P. Lingga; sterile coll.), Borneo (W. Sarawak).

Ecol. Locally frequent on yellow sandy soil on coastal hills and flat sometimes swampy land.

Vern. *Méranti bunbong* (Mal.).

**73. *Shorea farinosa*** C.E.C. FISCHER, Kew Bull. (1926) 461; *ibid.* (1927) 81; SYM. Mal. For. Rec. 16 (1943) 36, f. 19; SMITINAND, Thai For. Bull. (Bot.) 1 (1954) 23.

Large semi-deciduous tree. Leaf bud and parts of petals exposed in bud persistently cream pubescent, calyx and ovary thus at first, becoming sparsely pubescent; parts otherwise sparsely fugaceous puberulent, glabrescent. *Twig* 2–3 mm  $\varnothing$  apically, smooth, pale brown; stipule scars short, pale, slightly downcurved. *Leaves* 7.5–15 by (2–)2.5–6 cm, elliptic-oblong, thinly coriaceous; base obtuse; apex shortly acuminate or retuse; nerves 13–20 pairs, very slender, elevated on both surfaces, arched, at 60°–70°; tertiary nerves scalariform, evident on both surfaces; midrib slender but prominent and terete beneath, obscure and depressed above; *petiole* (13–)20–30 mm long, slender. *Panicles* to 10 cm long, lax, slender, terminal or axillary; singly branched, branchlets to 8 cm long, bearing to 6 distant second flowers; *flower buds* to 6 by 4 mm, broadly ellipsoid; 3 outer *sepals* ovate-elliptic, acute; 3 inner smaller, ovate, acute; *stamens* 25, filaments broad and compressed at base, gradually tapering; appendages filiform, villous in the distal  $\frac{1}{2}$ , *c.*  $1\frac{1}{2}$  times length of the narrowly oblong tapering anthers; *ovary* narrowly ovoid, tapering into the equally long columnar deeply trifid style. *Fruit pedicel* to 4 mm long, expanding into the base of the nut; 3 longer *calyx lobes* to 14 by 2 cm, spatulate, obtuse, *c.* 8 mm wide above the 18 by 14 mm elliptic saccate thickened base; 2 shorter lobes to 10 by 0.7 cm, slender. *Nut* to 3 by 1.5 cm, ovoid, glabrous, tapering to the prominent style remnant.

Distr. *S. Tenasserim*, Peninsular Thailand; doubtfully from *Malesia*: Malaya (fallen leaves from N. Perlis and Kelantan).

**74. *Shorea polita*** VIDAL, Sinopsis (1883) 15, t. 15D; Rev. Pl. Vasc. Filip. (1886) 61; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 88; FOXW. Philip. J. Sc. 13 (1918) Bot. 190; MERR. En. Philip. 3 (1923) 98; DESCH, Mal. For. Rec. 12 (1936) 39; FOXW. Philip. J. Sc. 67 (1938)

304. — *S. mindanensis* FOXW. Philip. J. Sc. 13 (1918) Bot. 192; MERR. En. Philip. 3 (1923) 97; REYES, Philip. J. Sc. 22 (1923) 330. — **Fig. 92.**

Large tree. Parts of petals exposed in bud densely pubescent, young parts  $\pm$  caducously tawny puberulent, more persistent in young trees. *Twigs* *c.* 2 mm  $\varnothing$  apically, terete, smooth. *Leaf buds* small, ovoid. *Stipules* caducous, not seen. *Leaves* (3.5–)6.5–9(–14) by (1.5–)4–5(–11.5) cm,  $\pm$  elliptic, thinly coriaceous, occasionally cream lepidote beneath; margin narrowly subrevolute; base cuneate to obscure (young trees); apex shortly broadly acuminate to retuse; nerves 11–13 pairs, slender but distinctly elevated beneath,  $\pm$  applanate above, at 55°–80°; tertiary nerves remotely scalariform, hardly elevated beneath,  $\pm$  obscure; midrib prominent beneath, obscurely depressed above; *petiole* 1–2 cm long, slender, geniculate. *Panicle* to 14 cm long, slender, lax, terminal or axillary; singly branched, branchlets to 8 cm long, with to 8 second flowers; *bracteoles* to 7 by 2 mm, lanceolate, acute, caducous. *Flower bud* to 10 by 3 mm, fusiform; *sepals* ovate, the outer 3 subacute, the inner 2 acuminate; *stamens* 21–25, becoming  $\pm$  shorter than style at anthesis; anthers linear-oblong, slender; appendages aristate, scabrous distally,  $\pm$  twice length of anthers; ovary ovoid, puberulent; style columnar, slender,  $\pm$  twice length of ovary, scarious in the basal  $\frac{1}{2}$ , with  $\pm$  deeply trifid stigma. *Fruit pedicel* short, stout, broadening into fruit. 3 longer *calyx lobes* to 13 by 2 cm, lorate, obtuse, *c.* 6 mm wide above the to 15 by 12 mm elliptic saccate thickened base; 2 shorter lobes to 7.5 by 0.5 cm, linear-lorate, acute, similarly saccate at base; *nut* to 15 by 14 mm, ovoid, tapering to a long slender filiform style remnant.

Distr. *Malesia*: Philippines.

Ecol. Widespread but scattered in Semi-evergreen and Evergreen Lowland Dipterocarp forests.

Vern. *Lauan*, *malaanonan*.

Note. Closely allied to *S. gratissima* and *S. montigena*, forming a group of three allopatric species characteristic of seasonally or periodically dry forests from Thailand to the Moluccas.

**75. *Shorea gratissima*** (WALL. ex KURZ) DYER, Fl. Br. Ind. 1 (1874) 307; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 115; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 88, 89; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 59; BRANDIS, Indian Trees (1906) 70; BURK. J. Str. Br. R. As. Soc. 16 (1917) 167; *ibid.* 81 (1920) 51, 68; RIDL. Fl. Mal. Pen. 1 (1922) 226; CRAIB, Fl. Siam. Enum. 1 (1925) 143; FOXW. Mal. For. Rec. 10 (1932) 189, *p.p.*; BURK. Dict. (1935) 2011; SYM. Mal. For. Rec. 16 (1943) 36, f. 19; SMITINAND, Thai For. Bull. 1 (1954) 22; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 54, f. 5. — *Hopea gratissima* WALL. [Cat. (1828) n. 960, *nomen*; DC. Prod. 16, 2 (1868) 635, *nomen*] ex KURZ, J. R. As. Soc. Beng. Sc. 42, 2 (1873) 61.

Large tree. Young parts entirely shortly evenly densely pale fulvous pubescent, glabrescent except on stipules *Twig* *c.* 1.5 by 1 mm  $\varnothing$  apically, at first somewhat compressed, becoming terete, smooth,

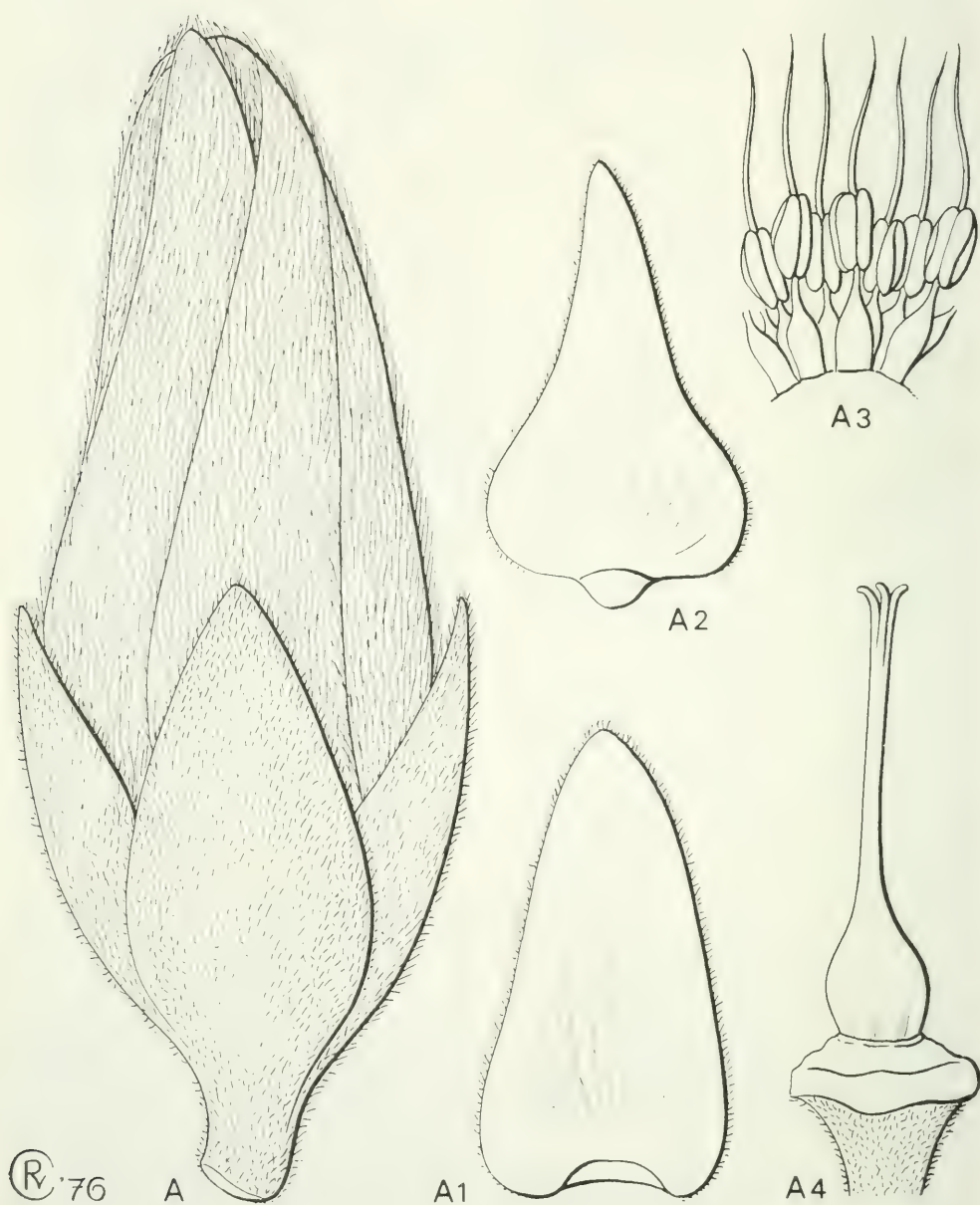


Fig. 92. Flower details in *Shorea* sect. *Anthoshorea* HEIM. — *S. polita* VIDAL. A. Bud, A1. outer sepal, A2. inner sepal, both from inside, A3. stamens from inside, A4. pistil, all  $\times 5$  (CANICOSA 9734).



dark brown; stipule scars short, horizontal, obscure. *Buds* to 2 by 1 mm, ovoid, subacute. *Stipules* to 10 by 3 mm, lanceolate, acute, caducous. *Leaves* 4–10 by 1.5–4.5 cm, ovate to elliptic, coriaceous, with undulate margin; base cuneate; apex acute or with to 1 cm long slender acumen; nerves c. 12–14 pairs, slender, hardly raised beneath, arched, at 55°–65°; secondary nerves scalariform to subreticulate, remote, obscure; midrib obscure and depressed above, slender and acute beneath; *petiole* 8–15 mm long, slender. *Panicles* to 10 cm long, terete or ribbed, terminal or axillary, singly (if axillary) or doubly branched; branchlets to 4 cm long, ascending, bearing to 8 flowers; *bracteoles* to 2 mm long, linear, fugaceous. *Flower bud* to 5 by 3 mm, lanceolate. *Sepals* narrowly deltoid, 3 outer acute, 2 inner acuminate. *Stamens* 25; filaments compressed, tapering, c. 1½ times length of anthers; anther oblong, tapering; appendages very slender, c. 3 times length of anthers, villous in the distal ½. *Ovary* narrowly ovoid, glabrescent, tapering into the style; style c. 1½ times length of ovary, with prominently trifid stigma. *Fruit* glabrescent. *Pedicel* to 1.5 mm long and ø; 3 longer *calyx lobes* to 7 by 1.3 cm, lorate-spatulate, obtuse, c. 6 mm wide above the to 8 by 5 mm saccate somewhat thickened base; 2 shorter lobes to 5.5 by 0.6 cm, otherwise similar. *Nut* to 15 by 8 mm, ovoid, apiculate.

Distr. Tenasserim, Peninsular Thailand, and in *Malesia*: Malaya (Kelantan, Selangor, Singapore), W. Sumatra (Bangkinang), Borneo (N.E. Sabah from Kudat to W. Kutei).

Ecol. Locally abundant on low hills near the coast.

Vern. *Meranti laut* (Malaya), *penggiran* (Sabah).

**76. *Shorea henryana*** PIERRE in Lanessan, Pl. Util. Colon. Fr. (1886) 302; For. Fl. Coch. 3 (1889) t. 229; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 89; CRAIB, Fl. Siam. Enum. 1 (1925) 143; ASHTON, Gard. Bull. Sing. 31 (1978) 41. — *S. sericeiflora* FISCHER & HUTCH. Kew Bull. (1926) 433; SYM. ex DESCH, Mal. For. Rec. 12 (1936) 27; PARKINSON, Ind. For. Rec. (Bot.) 1 (1937) 43; SYM. J. Mal. Br. R. As. Soc. 19 (1941) 160; Mal. For. Rec. 16 (1943) 41, f. 19, 25; SMITINAND, Thai For. Bull. 1 (1954) 22. — *S. gratissima* (non WALL. ex KURZ) DYER. FOXW. Mal. For. Rec. 10 (1932) 189. — *S. longestipulata* TARDIEU, Not. Syst. 10 (1942) 132. — **Fig. 91 C–C3.**

Large buttressed tree. Young twig and petiole densely evenly pale rufous caducous pubescent; leaf bud, panicles, sepals and parts of petals exposed in bud persistently so; leaves, stipules and ovary sparsely fugaceous pubescent; leaves pale pink-brown lepidote beneath. *Twigs* 1–2 mm ø apically, smooth, terete, becoming chocolate-brown; stipule scars slender, short, horizontal. *Buds* to 2 by 1 mm, small, ellipsoid. *Stipules* to 20 by 3 mm, narrowly elliptic, obtuse, not at first caducous. *Leaves* (3–)4–8(–12) by (1–)2.5–4.5(–5) cm, broadly lanceolate to elliptic, coriaceous; base obtuse or rarely broadly cuneate; apex acute or with to 1 cm long broad acumen; nerves 17–20 pairs, slender, hardly raised beneath, at 80° at

the base, down to 45° towards the apex; secondary nerves densely scalariform, slender, obscure; midrib obscure and depressed above, slender but prominent and terete beneath; *petiole* 10–18 mm long, slender. *Panicles* to 11 cm long, slender, lax, terete or ribbed, terminal or more rarely axillary; doubly (if terminal) or singly branched; branchlets to 5 mm long, bearing to 6 flowers; *bracteoles* unknown. *Flower buds* to 10 by 5 mm, ellipsoid. *Sepals* lanceolate, the inner 2 somewhat shorter, more narrowly acute, than the outer 3. *Petals* white. *Stamens* 25(–30); filaments slender, tapering, c. 1½ times length of the narrowly oblong anthers; appendages very slender, c. 3 times length of anther, villous towards apex. *Ovary* ovoid; style columnar, tapering, ± twice length of ovary, villous in the basal ½, prominently trifid at apex. *Fruit pedicel* to 3 mm long, to 2 mm ø; 3 longer *fruit calyx lobes* to 9.5 by 1.6 cm, lorate, obtuse, to 8 mm wide above the 8 by 8 mm suborbicular somewhat thickened saccate base; 2 shorter lobes to 5.5 by 0.4 cm, otherwise similar. *Nut* to 22 by 10 mm, narrowly ovoid, apiculate, glabrous.

Distr. Lower Burma, S.E. and Peninsular Thailand, and in *Malesia*: N.W. Malaya (Kedah, Perlis, Langkawi).

Ecol. Locally common in Semi-evergreen Dipterocarp forest on well drained red soils.

**77. *Shorea montigena*** SLOOT. Reinwardtia 2 (1952) 57, f. 18, 19. — *S. balangeran* var. *binnendijkii* BOERL. Cat. Hort. Bog. 2 (1901) 108.

Huge buttressed tree. Young parts fugaceous puberulent, ovary persistently so, panicle and parts of perianth exposed in bud persistently greyish ochraceous pubescent; parts otherwise glabrous. *Twigs* c. 2 by 1 mm apically, distinctly compressed, smooth, dark brown. *Buds* minute, falcate-lanceolate. *Stipules* to 20 by 3 mm, linear-lanceolate, acute. *Leaves* 5–12 by 2–5.5 cm, ovate-lanceolate, thinly coriaceous, undulate; base cuneate; apex with to 1.5 cm long slender tapering acumen; nerves 7–9(–13 in young trees) pairs, very slender and hardly elevated on either surface, ascending at 50°–65°, sometimes with a few scattered shorter secondary nerves; tertiary nerves densely scalariform, ± obscure; midrib slender but prominent and acute beneath, ± obscure and depressed above; *petiole* 22–25 mm long, slender, geniculate. *Panicles* to 17 cm long, axillary or terminal, compressed, singly or doubly branched; branchlets to 12 cm long; *bracts* fugaceous. *Flower bud* to 12 by 4 mm, large; *sepals* broadly ovate, acute, subequal; *stamens* (55–)65–72, unequal; filaments compressed, tapering; appendages slender, 1½–2 times length of the narrowly oblong anthers; *ovary* ovoid, tapering into somewhat longer columnar style. *Fruit pedicel* short; 3 longer *calyx lobes* to 11 by 1.5 cm, spatulate, obtuse, 1.5 mm wide above the 1 by 1 cm ovate saccate thickened base; 2 shorter lobes to 35 by 3 mm, linear, similar at base. *Nut* to 2 by 1.5 cm, ovoid, apiculate.

Distr. *Malesia*: Moluccas (Buru, Ceram), N.E. Celebes? (leaves only).



Fig. 93. *Shorea assamica* DYER ssp. *globifera* (RIDL.) SYM. a. Habit, b. seedling, c. leaf, showing hairs in the left half, veins in the right, d. fruit, e. nut, all  $\times \frac{1}{2}$  (a YATES 1675, b bb. 19473, c bb. 20776, d-e KEP 87603).



Ecol. Common, frequently gregarious, on hills in *S. selanica* forest.

Vern. *Bahut, kayu bapa, gawa, babat* (Buru), *umale* (Ceram).

Notes. Differing from the Philippine species *S. polita* principally in the greater number of stamens and related, through it, to the widespread but disjunct *S. gratissima* of drought prone evergreen forest. GOTTWALD & PARAMESWARAN (Bot. Jahrb. 85, 1966, 457, 458) placed this species in *sect. Shorea* on the basis of xylem anatomy, but noted its unusually low density for that section, the presence of oxalate crystals and red colour.

**78. *Shorea assamica*** DYER, Fl. Br. Ind. 1 (1874) 307; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 85; Indian Trees (1906) 70; FOXW. Philip. J. Sc. 4 (1909) Bot. 516; TROUP, Ind. Woods and Uses (1909) 241; Silv. Ind. Trees (1921) 133; GAMBLE, Man. Ind. Timb. (1922) 83; PEARSON & BROWN, Comm. Timb. Ind. 1 (1932) 119; KANJILAL & DAS, Fl. Assam (1934) 136; PARKINSON, Ind. For. Rec. (Bot.) 1 (1937) 40; SYM. Gard. Bull. S. S. 9 (1938) 331; ASHTON, Gard. Bull. Sing. 31 (1978) 43. — **Fig. 93.**

#### KEY TO THE SUBSPECIES

1. Branchlets of panicle usually simple *ssp. assamica*
1. Branchlets of panicle bifurcate or fascicled.
  2. Appendage to connective as long as anther *a. ssp. globifera*
  2. Appendage to connective twice length of anthers.
    3. Leaves epilose beneath *b. ssp. koordersii*
    3. Leaves usually sparsely velutinate beneath *c. ssp. philippinensis*

**a. *ssp. globifera*** (RIDL.) SYM. Gard. Bull. S. S. 9 (1938) 331, pl. 20; Mal. For. Rec. 16 (1943) 31, f. 19, 20; ASHTON, Gard. Bull. Sing. 31 (1978) 44. — *S. globifera* RIDL. Fl. Mal. Pen. 1 (1922) 232; FOXW. Mal. For. Rec. 3 (1927) 35; *ibid.* 10 (1932) 191; BURK. Dict. (1935) 2010; SYM. ex DESCH, Mal. For. Rec. 12 (1936) 27. — *S. sororia* SLOOT. Bull. Bot. Gard. Btzg III, 18 (1949) 247, f. 9, 10. — **Fig. 93.**

Large buttressed tree. Twigs, panicles, parts of perianth exposed in buds, stipules outside (subglabrous to sparsely puberulent within), petioles, midribs above and leaf undersurface persistently  $\pm$  densely shortly evenly pale ochraceous buff to rufous pubescent; fruit sparsely persistently puberulent; leaf undersurface densely pale rufous lepidote (mature trees only). Twigs to 2 by 1.5 mm  $\varnothing$  apically,  $\pm$  compressed, smooth, becoming dark brown; stipule scars short, pale, transverse, with a prominent rib proceeding down the internode from the base. Buds to 3 by 2 mm, ovoid, subacute, compressed. Stipules to 15 by 4(–7 in young trees) mm, broadly or narrowly ovate, acute, subauriculate, not at first caducous. Leaves (4–)5–9(–10) by 2–4(–6) cm, ovate, elliptic or rarely obovate,  $\pm$  coriaceous; base obtuse to subcordate; acumen to 8 mm long, narrow; nerves 13–18 pairs,

slender, obscure above, at 50°–65°, arched near the margin; tertiary nerves densely scalariform, slender; midrib obscurely depressed above, terete and prominent beneath; petiole 5–7 mm long, short, slender. Panicles to 6 cm long, short, ribbed, terminal or axillary; branchlets usually bifurcate or fascicled, lax. Flower bud to 8 by 4 mm, ellipsoid. Sepals narrowly deltoid, subacute, the 3 outer somewhat narrower, longer than the inner 2. Petals white, pink at base within, broadly elliptic, obtuse. Stamens 15, shorter than the style at anthesis; filaments slender, tapering, as long as the slender lorate anthers; appendages to connectives very slender,  $\frac{3}{4}$ –1 times length of anthers. Ovary ovoid, glabrous; style columnar, c. 3 times length of ovary, distinctly trifid at apex. Fruit pedicel to 2 by 2 mm. 3 longer calyx lobes to 11 by 2 cm, sublorate, obtuse, c. 5 mm broad above the to 12 by 10 mm saccate thickened base; 2 shorter lobes to 9 by 0.8 cm, linear, subacute, similar at base. Nut to 15 by 15 mm, ovoid, tapering to an up to 6 mm long slender style remnant.

Distr. Peninsular Thailand, and in *Malesia*: Malaya (Perak and Central Pahang northwards), Sumatra (west of the Barisan Divide from S. Atjeh to Bencoolen), ?S.E. Borneo (sterile coll.).

Ecol. Evergreen forests on fertile clay soil; on well drained flat land, especially by streams, and slopes to 1000 m; in areas liable to periodic drought. Locally common, especially in northern Malaya.

Vern. *Mèrantî pipit, m. lampong, m. pasir, lèmsa kulat, l. nèram* (Mal.), *sogar baringin nabotar, s. b. narara, bayang ayèr, kèlikung, ngèrawan, mèrkunyt* (Sum.).

Note. Indistinguishable from *ssp. philippinensis* when sterile.

**b. *ssp. koordersii*** (BRANDIS) SYM. Gard. Bull. S. S. 9 (1938) 331. — *S. koordersii* BRANDIS ex KOORD. Med. Lands Pl. Tuin 19 (1898) 355; Ic. Bog. 1 (1901) t. 80; Fl. N.O. Celebes Suppl. 2 (1922) 8; *ibid.* Suppl. 3 (1922) 44, t. 91; KOORD.-SCHUM. Syst. Verz. 3 (1914) 88; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 303; *ibid.* ed. 2 (1927) 1107, 1120; ENDERT, Tectona 28 (1935) 258; SLOOT. Reinwardtia 2 (1952) 42, f. 14, 15. — *Aporosa minahassae* KOORD. Med. Lands Pl. Tuin 19 (1898) 625. — *Vatica celebica* KOORD. ex SYM. Gard. Bull. S. S. 9 (1938) 331, *nomen in syn.*

Defining characters: Leaves peltate lepidote but epilose beneath. Branchlets of panicle usually bifurcate or fascicled. Appendage to connective  $\pm$  twice length of anther. Stigma  $\pm$  unlobed. 3 longer fruit calyx lobes to 7 cm long.

Distr. *Malesia*: Celebes (widespread), Moluccas (Sula, Batjan & Obi Is., ?Ambon), Philippines (Mindanao, Luzon).

Ecol. Common, often gregarious, on fertile soil in primary semi-evergreen forest on hills in lowlands.

Uses. The major timber source where it grows; the clear crystalline resin, '*damar tenang*', was once much exploited.

Vern. *Malueh, haro, waro, rama wuring, induk,*

*tambija*, *damar lari*, *d. larieh*, *maru waru*, *karmungku* (Celebes), *honi*, *pini*, *p. boti pien*, *tēnang*, *t. puteh*, *t. mērah*, *t. babudo* (Moluccas).

**c. ssp. *philippinensis*** (BRANDIS) SYM. Gard. Bull. S. S. 9 (1938) 331. — *S. philippinensis* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 88; FOXW. Philip. J. Sc. 6 (1911) Bot. 272; *ibid.* 13 (1918) Bot. 190; *ibid.* 67 (1938) 302; MERR. En. Philip. 3 (1923) 98; DESCH, Mal. For. Rec. 12 (1936) 27. — *S. aff. harmandii* (non PIERRE) FOXW. Philip. J. Sc. 6 (1911) Bot. 272. — *S. pallida* FOXW. Philip. J. Sc. 13 (1918) Bot. 190.

Defining characters as *ssp. koordersii* but leaves sparsely velutinate beneath.

Distr. *Malesia*: Philippines (widespread), S.E. Borneo.

Ecol. Scattered in semi-evergreen and evergreen forest both in seasonal and relatively non-seasonal regions.

**79. *Shorea ochracea*** SYM. Gard. Bull. S. S. 8 (1935) 285, pl. 27; BROWNE, For. Trees Sarawak & Brunei (1955) 158; ASHTON, Man. Dipt. Brun. (1964) 165, f. 15; *ibid.* Suppl. (1968) 94, pl. 19 (bark); MEIJER & WOOD, Sabah For. Rec. 5 (1964) 57. — '*Majau*' DURANT, Rep. For. Brunei (1933) 43.

Medium-sized to large tree with dark brown bark. Twig, leaf bud, stipule and petiole densely persistently rufous-brown powdery pubescent; partially caducous, sparse, on leaf beneath. Twig 4–5 mm  $\varnothing$  apically, stout, terete, becoming smooth, with 2 mm long, short, cuneate, horizontal or slightly ascending stipule scars. Bud 3–6 by 3–5 mm, globose to ovoid, obtuse. Stipule to 2 by 1.5 cm, elliptic, obtuse, caducous. Leaves 12–18 by 7–10 cm, broadly elliptic-oblong, coriaceous, bright yellow lepidote beneath; base cordate; acumen c. 5 mm broad; nerves 25–30 pairs, prominent beneath, curved, at c. 110° at base, c. 20 towards the apex, with slender indistinct scalariform tertiary nerves; petiole 1.3–2 cm long, short, stout. Panicle to 10 cm long, terminal or axillary, terete, lax, densely greenish yellow puberulent; regularly singly or doubly branched, branchlets bearing to 8 flowers; bracts and bracteoles to 2 by 1 cm, large, elliptic, obtuse, subpersistent, puberulent. Flower bud to 8 by 3 mm, lanceolate, subacute. Calyx densely yellow-brown tomentose outside, glabrous within; lobes deltoid, slightly revolute, acuminate; 3 outer lobes slightly longer, broader, obtuse; 2 inner lobes acute, narrow at base. Petals lanceolate, subacute, shortly pubescent on parts exposed in bud, puberulent elsewhere. Stamens 15, subequal; filaments slightly longer than anther, rather narrow, tapering gradually; anther oblong, tapering; appendage to connective somewhat longer than anther, reaching below style apex, stout, acute. Ovary ovoid, densely pubescent; style stoutly filiform, pubescent in the basal half, otherwise glabrous, obscurely trifurcate apically. Fruit calyx lobes shortly pubescent, densely so at base; 3 longer lobes to 10 by 2 cm, oblong, obtuse, to 1 cm broad above the slightly broadened shortly auriculate

centrally thickened and saccate base; 2 shorter lobes unequal, to 4.5 by 0.5 cm, obtuse, similar at base. Nut c. 1.5 by 1 cm, ovoid, shortly densely tomentose; style remnant to 2.5 mm long.

Distr. *Malesia*: Borneo (Lower Kapuas, Sarawak to S.W. Sabah, Kinabatangan, Tidung to Puruktjau).

Ecol. Scattered on undulating land and hills to 750 m, in Mixed Dipterocarp forest.

Vern. *Raruk* (Iban), *mēlapi daun bēsar* (Sabah), *maro*, *m. hitam*, *kodahang* (S.E. Borneo), *kotoi tēmbaga* (W. Borneo).

**80. *Shorea virescens*** PARIJS in Fedde, Rep. 33 (1933) 244; Bijdr. Kennis Oost-Ind. Damarhars (1933) 120; SLOOT, Bull. Bot. Gard. Btzig III, 18 (1949) 240, f. 5, 6; ROJO, Kalikasan 5 (1976) 99, f. 1; ASHTON, Gard. Bull. Sing. 31 (1978) 44. — *S. lamellata* (non FOXW.) ASHTON, Man. Dipt. Brun. (1964) 167, f. 15, *p.p.*; *ibid.* Suppl. (1968) 94, *p.p.*

Twig, panicle, bud, stipule, petiole, midrib (both surfaces) and nervation beneath shortly densely persistently grey-buff tomentose. Twig 2.5–4 by 1.5–3 mm, compressed, becoming finely cracked, stipule scars c. 2.5 mm long, glabrous, horizontal. Bud 2–3 by 4 mm, globose to stoutly ovoid, obtuse. Stipule to 25 by 3–4 mm, linear, acute. Leaves alternate, 8–15 by 4–8 cm, obovate; base subcordate; acumen to 7.5 mm long, nerves 20–26 pairs, at 90° at base, c. 40°–55° along the midrib; tertiary nerves very slender, scalariform, dense at 90° to the nerves; petiole 1.5–2 cm long. Panicle to 10 cm long, terminal or axillary  $\pm$  compressed, slender, straight; unbranched or singly branched; bracteoles to 8 mm long, narrowly lanceolate, densely pubescent outside, puberulent within, caducous. Flower bud to 6 by 3 mm, ellipsoid, obtuse. Calyx densely puberulent outside, glabrescent within; 3 outer lobes ovate, subacute; 2 inner lobes shorter, smaller, thinner, ovate-acuminate. Petals narrowly lanceolate, densely pubescent on parts exposed in bud. Stamens 15, of 2 lengths; filaments broad at base, tapering and filiform distally; anthers narrowly oblong; appendage to connective about twice length of anther, exceeding style apex. Ovary ovoid, minutely puberulent; style filiform, as long as ovary, distinctly trifid. Fruit calyx shortly puberulent or glabrous when mature; 3 longer lobes to 8 by 1.3 cm, spatulate,  $\pm$  obtuse, to 6 mm broad above the to 8 by 7 mm elliptic somewhat thickened saccate base; 2 shorter lobes to 5.5 by 0.5 cm, linear, similar at base. Nut to 1.3 by 1 cm, glabrescent; style remnant to 3 mm long, tapering.

Distr. *Malesia*: Borneo, Philippines (Mindanao, Samar).

Ecol. Widespread but very local, flat and undulating land and low hills, to 500 m.

Vern. *Kēbang*, *baung raja*, *pakit*, *kotoi raba*, *k. tjongil*, *madja kēruing*, *m. lilin* (W. Borneo), *mahumbong* (S. Borneo), *tēgēlam*, *bēlobunio*, *pēlēpak batu* (S.E. Borneo), *manggasinorong-lakihan* (Mindanao).

**81. *Shorea javanica*** K. & V. Bull. Inst. Bot. Btzig 2 (1899) 3; Bijdr. (1900) 121; MOLL & JANSONIUS,



Mikrogr. Holz (1906) 361; BACKER, Schoolfl. (1911) 110; KOORD. Exk. Fl. Java 2 (1912) 622; KOORD.-SCHUM. Syst. Verz. 1 (1913) Dipt. 4; ENDERT, Tectona 28 (1935) 288, 488; SLOOT. Bull. Bot. Gard. Btzig III, 18 (1949) 230, f. 1; BACKER & BAKH. f. Fl. Java 1 (1963) 331. — *S. vandekeppelii* PARIJS in Fedde, Rep. 33 (1933) 244; Bijdr. Kennis Oost-Ind. Damarhars (1933) 112, incl. var. *grandifolia* PARIJS, l.c. 118. — **Fig. 16.**

Large tree. Twig, leaf buds, stipule outside, panicles, calyx, parts of petals exposed in bud, ovary and nut persistently evenly tawny brown pubescent; becoming sparse, scabrous, on fruit calyx, stipule within, petiole and leaf nervation beneath. *Twig* 2–3 mm  $\varnothing$  apically, terete, becoming smooth. *Leaf bud* to 7 by 4 mm, ovoid-falcate, acute. *Leaves* (6.5–)10–15 by (3.5–)4–8 cm, elliptic-oblong to ovate, occasionally obovate,  $\pm$  thinly coriaceous; base obtuse to shallowly caudate; acumens to 7 mm long, short,  $\pm$  abrupt; nerves 19–25 pairs, very slender but  $\pm$  prominent beneath, applanate above, arched, at 65°–70°; tertiary nerves densely scalariform, very slender but evident and slightly elevated beneath; midrib slender but prominent beneath, obscure and depressed above; *petiole* 16–22 mm long, slender. *Panicle* to 14 cm long, slender, terminal or axillary, lax; singly branched, branchlets to 4 cm long, bearing to 3 second flowers. *Flower buds* to 10 by 5 mm, ellipsoid; *sepals* narrowly ovoid, acuminate, somewhat unequal; *petals* white; *stamens* 15, shorter than style at anthesis; filaments very long and slender, with scabrous apices,  $2\frac{1}{2}$ –3  $\times$  length of anthers. *Ovary* small, ovoid, puberulent, tapering imperceptibly into a tapering puberulent stylopodium twice its length and long filiform glabrous style thrice its length. *Fruit pedicel* c. 2 mm long and  $\varnothing$ , base of fruit obtuse. 3 longer *calyx lobes* to 18 by 1.5 cm, spatulate, obtuse, c. 7 mm broad above the 11 by 10 mm elliptic saccate thickened base; 2 shorter lobes to 7 by 0.5 cm, lorate, subacute, similar at base. *Nut* to 14 by 10 mm, ovoid, prominently apiculate.

Distr. *Malesia*: Sumatra (W. coast from southern Atjeh southwards; east from Palembang southwards), Central Java (Subah in Pekalongan Res.; rare).

Ecol. Scattered in north, becoming gregarious in many areas in south Sumatra, in primary and secondary lowland forests.

Uses. A once valuable producer of clear crystalline resin as well as timber; grown in plantations in *S. Sumatra*.

Vern. *Damar puteh* (Atjeh), *d. sibosa*, *sibosa* (Tapanuli), *d. saga* (W. coast), *d. kacha*, *d. mata kuching* (Palembang), *mēsēgar*, *mēntēgar*, *kacha* (Bencoolen), *d. ata*, *d. dacha*, *d. mata kuching* (Lampung), *pēlalar*, *p. lēngō* (Java).

**82. *Shorea lamellata*** Foxw. Mal. For. Rec. 10 (1932) 278; BURK. Dict. (1935) 2014; DESCH. Mal. For. Rec. 12 (1936) 27, 28; *ibid.* 14 (1941) 16, 17; SYM. Mal. For. Rec. 16 (1943) 39, f. 19, 23; SLOOT. Bull. Bot. Gard. Btzig III, 18 (1949) 236, f. 3; ASHTON, Man. Dipt.

Brun. (1964) 164, f. 15, pl. 40 (stem-base), *p.p.*; *ibid.* Suppl. (1968) 94, *p.p.*; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 56, pl. 1a (bark).

Differing from *S. javanica* only as follows: Tomen-tum uneven, scabrid. Anthers twice as long as broad, broadly oblong.

Distr. *Malesia*: Malaya (Perak), Sumatra (Lingga, Singkep), throughout Borneo but for N.E. Sarawak and N. and W. Sabah.

Ecol. Local, undulating land and low hills; rarely to 650 m in Malaya.

Vern. *Mēranti lapis* (Mal.), *tenam* (W. Borneo), *buniau* (W. Kutei), *pakit* (S. Borneo).

Note. The distribution of this species and *S. javanica* is entirely allopatric; both are widespread, and the many collections of each confirm that their differences, though apparently slight, are consistent and serve always to allow indisputable determination.

**83. *Shorea roxburghii*** G. DON, Gen. Hist. (1831) 813; KASHYAPA, J. Bomb. Nat. Hist. Soc. 58 (1961) 543. — *Hopea floribunda* WALL. Cat. (1828) 964, *nomen*; DC. Prod. 16, 2 (1868) 635, *nomen*. — *S. talura* ROXB. [Hort. Beng. (1814) 93, *nomen*] Fl. Ind. ed. Carey 2 (1832) 618; DYER, Fl. Br. Ind. 1 (1874) 304; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 84; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 265, fig.; BRANDIS, Indian Trees (1906) 70; TALBOT, For. Fl. Bombay 1 (1909) 110; TROUP, Silv. Ind. Trees (1921) 133; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 261; PARKINSON, Ind. For. Rec. (Bot.) 1 (1937) 38; SYM. J. Mal. Br. R. As. Soc. 19 (1941) 160; Mal. For. Rec. 16 (1943) 42, f. 19, 26; SMITINAND, Thai For. Bull. 1 (1954) 5, 6, 23. — *S. laccifera* HEYNE ex WALL. [Cat. (1828) 967, *nomen*] in DC. Prod. 16, 2 (1868) 630; BEDD. Fl. Sylv. (1869) t. 6. — *Vatica laccifera* (WALL. ex DC.) W. & A. Prod. 1 (1834) 84; WIGHT, Ic. Pl. Ind. Or. 1 (1839) t. 164. — *Saul iallarea* ROXB. ex W. & A. Prod. 1 (1834) 84, *nomen*. — *S. laurifolia* WALL. Cat. (1828) 967, *nomen*; ex STEUD. Nom. Bot. ed. 2, 2 (1841) 575, *nomen*; DC. Prod. 16, 2 (1868) 632, *nomen*. — *Vatica laurifolia* (WALL.) STEUD. Nom. Bot. ed. 2, 2 (1841) 745, *nomen*. — *S. floribunda* (WALL.) KURZ ex DYER, Fl. Br. Ind. 1 (1874) 304; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 85, t. 2, f. 19, 20; Indian Trees (1906) 70; SYM. J. Mal. Br. R. As. Soc. 19 (1941) 160. — *S. harmandii* PIERRE ex LANESSAN, Pl. Util. Colon. Fr. (1886) 302; PIERRE, For. Fl. Coch. 3 (1889) t. 231; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 85; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 266. — *S. cochinchinensis* PIERRE, For. Fl. Coch. 3 (1889) t. 230; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 84; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 266; GUÉRIN, Fl. Gén. I.–C. 1 (1910) 381, fig., incl. var. *saigonensis* GUÉRIN; CRAIB, Fl. Siam. Enum. 1 (1925) 142; LECOMTE, Bois Indochine (1926) 112; Foxw. Mal. For. Rec. 10 (1932) 182; BURK. Dict. (1935) 2008; CORNER, Wayside Trees 1 (1940) 213. — *S. saigonensis* PIERRE, For. Fl. Coch. 3 (1889) 257. — *S. attopoensis* PIERRE, l.c. 257, t. 232. — *S. obtusa* WALL.

*var. subevenis* BOERL. Cat. Hort. Bog. 2 (1900) 106. — **Fig. 91 B–B4.**

Small or large, hardly buttressed, deciduous or evergreen tree. Leaf bud persistently shortly evenly pale rust pubescent, leaf undersurface, petiole, stipules and young twigs usually at first  $\pm$  sparsely pubescent, caducous (in Malesia) or sometimes persistent. *Twigs* c. 2 mm  $\varnothing$  apically,  $\pm$  terete, becoming smooth, pale to dark brown, sometimes minutely pale lenticellate; stipule scars short, horizontal, the internode frequently ribbed beneath their apices. *Buds* to 4 by 2 mm, ellipsoid. *Stipules* to 10 by 3 mm, linear obtuse. *Leaves* 7.5–19 by 2.5–7 cm, elliptic-oblong, thin; margin undulate; base broadly cuneate to subcordate; apex acute or with to 6 mm long, short, broad acumen; nerves 12–20 pairs, slender, rather prominent beneath, tending to bifurcate near the margin, rather straight, at c. 60°–70°; secondary nerves slender, remote, subscalariform; midrib evident towards base, appanate to somewhat depressed, above, prominent and terete beneath; *petiole* 1.4–4.5 cm long, frequently somewhat swollen in the distal half and geniculate. *Panicle* to 8 cm long, axillary to ramiflorous, rarely terminal, slender, terete, glabrescent, lax; singly branched, branchlets to 4 cm long, ascending, bearing to 3 flowers; *bracteoles* fugaceous. *Flower buds* to 8 by 4 mm, lanceolate. *Sepals* glabrescent, fimbriate, deltoid, acute, the 2 inner somewhat the shorter, subacuminate. *Petals* white, tinged red at base within. *Stamens* 15; filaments slender, compressed, tapering, equal to the lorate anthers as also the slender filiform appendages. *Ovary* ovoid, glabrous; style slender filiform, c. 4 times length of ovary, obscurely trifid. *Fruit* glabrous. *Pedicle* obscure, expanding into the receptacle; 3 longer *calyx lobes* to 9 by 1.2 cm, spatulate, obtuse, c. 4 mm  $\varnothing$  above the to 10 by 7 mm ovate saccate thickened lustrous base; 2 shorter lobes to 4.5 by 0.6 cm, lorate, otherwise similar. *Nut* to 15 by 10 mm, narrowly ovoid, tapering to an up to 5 mm slender filiform style remnant.

Distr. Peninsular India, Burma, Thailand, Indochina and in *Malesia*: N.W. Malaya (Kedah, Perlis, Langkawi).

Ecol. Common, locally gregarious in *Schima*-bamboo forests and on limestone; also occurring in Semi-evergreen Dipterocarp forests (outside Malesia in teak and other deciduous forests and in semi-evergreen forests).

Vern. *Tĕmak* (Mal.).

**84. *Shorea bentongensis*** FOXW. Mal. For. Rec. 10 (1932) 169, pl. 12; BURK. Dict. (1935) 2007; SYM. Gard. Bull. S. S. 8 (1935) 280, pl. 24; Mal. For. Rec. 16 (1943) 33, f. 19. — *S. pahangensis* FOXW. Mal. For. Rec. 10 (1939) 193, pl. 15; BURK. Dict. (1935) 2019.

Large buttressed tree. Young twigs, leaf buds, stipules outside (glabrous within) petiole and raceme  $\pm$  persistently evenly shortly buff to pale rufous pubescent; leaf nervation beneath and midrib above sparsely puberulent or glabrescent; ovary densely caducous puberulent. *Twigs* c. 2 mm  $\varnothing$  apically, terete

to slightly compressed, becoming smooth, dark brown; stipule scars short, pale, transverse. *Buds* to 3 by 2 mm, ellipsoid, obtuse. *Stipules* to 12 by 7 mm, broadly elliptic, obtuse, caducous. *Leaves* 7–15 by 4–8 cm, broadly ovate, rarely obovate, coriaceous; margin subrevolute; base subcordate to broadly cuneate; acumen to 1.5 cm long, prominent, slender; nerves 13–16 pairs, prominent beneath, curved, set at 50°–65°; secondary nerves scalariform, slender; midrib obscure, depressed above, terete and prominent beneath; *petiole* 8–13 mm long, short, stout. *Panicles* to 6 cm long, terminal or axillary, terete, singly branched; *bracteoles* unknown. *Mature flowers* unknown: *Sepals* narrowly deltoid, the 3 outer acute, the 2 inner prominently acuminate. *Petals* pale yellow. *Stamens* 15; filaments equal to anthers, lorate, tapering; anthers oblong-orate; appendages very slender, c. 3 times length of anthers. *Ovary* ovoid, surmounted by an equally long puberulent cylindrical tapering stylopodium and equally long tapering style. *Fruit* glabrous. *Pedicle* to 3 by 3 mm, stout, becoming impressed. *Calyx lobes* vestigial; 3 longer lobes to 7.5 by 0.8 cm, lorate, obtuse, tapering slightly above the to 20 by 23 mm large prominently saccate thickened base; 2 shorter lobes with only to 12 by 2 mm linear projection above the similar base. *Nut* to 20 by 25 mm, subglobose, resinous, hidden in the sepals, crowned by an up to 4 mm long linear style remnant.

Distr. *Malesia*: Malaya (Selangor, Pahang, Johore).

Ecol. Local, low lying land in deep valleys.

Vern. *Mĕranti mĕngkai*, *m. sĕga*, *bok*.

**85. *Shorea hypochra*** HANCE, J. Bot. 14 (1876) 242; PIERRE, For. Fl. Coch. 3 (1889) t. 228; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 89; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 266; GUÉRIN, Fl. Gén. I.-C. 1 (1910) 383; CRAIB, Fl. Siam. Enum. 1 (1925) 143; FOXW. Mal. For. Rec. 10 (1932) 187; BURK. Dict. (1935) 2012; SYM. Mal. For. Rec. 16 (1943) 37, f. 19, 22. — *S. maritima* PIERRE in Lanessan, Fl. Util. Colon. Fr. (1886) 302; For. Fl. Coch. 3 (1889) t. 229; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 89. — *S. cambodiana* PIERRE, For. Fl. Coch. 3 (1889) t. 229; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 89. — *S. crassifolia* RIDL. Fl. Mal. Pen. 1 (1922) 231.

Very large tree. Young parts evenly densely pale golden pubescent, fugaceous except on stipule, panicle, sepals and parts of petals exposed in bud; leaf undersurface and petiole persistently pinkish to cream lepidote (young tree excepted). *Twig* c. 4 by 3 mm towards apex, stout, somewhat compressed, becoming smooth to slightly rugulose, terete, pale brown; stipule scars short, horizontal, obscure. *Buds* to 4 by 3 mm, broadly ovoid, acute. *Stipules* to 4 by 3 mm, ovate, obtuse, caducous. *Leaves* 7–18 by 4.5–8 cm, ovate to elliptic, thickly coriaceous; base broadly cuneate to obtuse; apex obtuse, acute or with to 1 cm long stout acumen; nerves 15–20 pairs, slender, rather straight, at to 90° at the base, to 50° near the apex; secondary nerves slender, subreticulate; midrib ob-



scure and depressed above, prominent and terete beneath; *petiole* 2–4 cm long, terete, stout. *Panicles* to 20 cm long, terminal or axillary, somewhat compressed, singly branched; branchlets to 7 cm long, lax, bearing to 4 flowers; *bracteoles* unknown. *Flower bud* to 10 by 5 mm, lanceolate. *Sepals* lanceolate, acute, subequal, the outer 3 acute, the inner 2 acuminate. *Petals* pale yellow. *Stamens* 15; filaments slender, tapering, equal in length to the narrowly oblong anthers; appendages slender, c.  $1\frac{1}{2} \times$  length of anthers. *Ovary* ovoid, deeply trifid at apex. *Fruit pedicel* to 6 mm long, c. 4 mm  $\varnothing$ , stout, expanding into the base of the fruit. *3 longer calyx lobes* to 17 by 2.6 cm, lorate, obtuse or subacute, c. 8 mm wide above the to 2 by 1.5 cm elliptic saccate thickened base; 2 shorter lobes to 12 by 0.9 cm, slender, otherwise similar. *Nut* to 4.5 by 2.5 cm, ovoid, glabrous, tapering to the 4 mm long tapering style remnant.

Distr. Cochinchina, Cambodia, S.E. and Peninsular Thailand, and in *Malesia*: Malaya (Selangor and Pahang northwards) and N.E. Sumatra (Riouw, Lingga).

Ecol. Locally common on flat land and undulating hills near the coast, and on inland hills in more seasonal zone, in Semi-evergreen Dipterocarp forest and Evergreen Dipterocarp forest prone to periodic drought.

Vern. *Měranti tēmāk, tēmāk, t. bunga, t. nasi, t. kacha, tērbāk, t. paya, m. tērbāk.*

**86. *Shorea symingtonii*** WOOD, Gard. Bull. Sing. 17 (1960) 493; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 57, pl. 1b (phot.), f. 6.

Very large buttressed tree. Parts of petals exposed in bud densely persistently pubescent; twig apices, leaf buds and stipules  $\pm$  persistently densely tawny puberulent; petiole, nervation beneath, calyx and panicle sparsely caducously so. *Twig* c. 4 by 2 mm, stout,  $\pm$  compressed, becoming dark brown, terete. *Buds* c. 4 by 3 mm, ovoid-falcate, acute. *Stipules* to 12 by 5 mm, lanceolate, acute, fugaceous. *Leaves* (9–)10–18 by (4–)5–8 cm, oblong to narrowly obovate, coriaceous; base cordate or obtuse; apex tapering abruptly to 1 cm long acumen; nerves 18–22 pairs, prominent beneath, typically shallowly depressed above, at  $45^\circ$ – $70^\circ$  the base excepted; tertiary nerves densely scalariform, elevated beneath, evident above; midrib stout beneath, evident and  $\pm$  depressed above; *petiole* 1–2 cm long, stout. *Panicle* to 17 cm long, lax, pendant, terminal or axillary; singly branched, branchlets to 11 cm long, bearing to 5 flowers. *Flower bud* to 10 by 4 mm, large, fusiform. *Sepals* lanceolate, slender, sub-acuminate, slightly unequal. *Stamens* 15, shorter than style; filaments rather short, broad and compressed at base, tapering; anthers narrowly oblong; appendages slender, scarious near apices, c.  $2\frac{1}{2} \times$  length of anthers; *ovary* ovoid, puberulent; style stoutly columnar, obscurely trifid at apex, sparsely puberulent in the basal  $\frac{1}{2}$ . *Fruit pedicel* c. 5 mm  $\varnothing$ , very stout and prominent, expanding into the receptacle. *3 longer calyx lobes* to 18 by 2.5 cm, lorate-lanceolate, obtuse to subacute,

not tapering above the concave incrassate base; 2 shorter lobes to 13 by 1.5 cm, narrower, acute but otherwise as in longer lobes. *Nut* to 2.5 by 1 cm, narrowly ellipsoid-ovoid, prominently apiculate.

Distr. *Malesia*: Borneo (E. Sabah).

Ecol. Scattered on well drained undulating land in Mixed Dipterocarp forest below 250 m.

Vern. *Mělapi bunga.*

**87. *Shorea retinodes*** SLOOT. Bull. Bot. Gard. Btzg III, 18 (1949) 243, f. 7–8.

Large buttressed tree. Young twigs, leaf buds, outside of stipules and parts of petals exposed in bud  $\pm$  persistently grey-brown puberulent; panicle, calyx, leaf nervation beneath and petiole fugaceous so (densely pubescent in young trees). *Twig* c. 1 mm  $\varnothing$  apically, terete, slender, much branched. Leaf bud minute. *Stipules* to 8 mm long, linear, fugaceous. *Leaves* 5.5–12 by 1.8–4.8 cm, narrowly elliptic to lanceolate, thinly coriaceous, dull densely lepidote and drying coppery brown beneath; base broadly cuneate to obtuse; acumen to 1 cm long, tapering; nerves 15–18 pairs, slender but distinctly elevated beneath, evident above, ascending at  $50^\circ$ – $65^\circ$ ; tertiary nerves densely scalariform,  $\pm$  unraised,  $\pm$  obscure; midrib slender but prominent beneath, obscurely depressed above; *petiole* 12–20 mm long, slender, geniculate. *Panicle* to 12 cm long, slender, terminal or axillary,  $\pm$  doubly branched; flowers secund; *bracteoles* fugaceous. *Flower buds* to 6 by 3 mm, fusiform. *Sepals* ovate, the outer 3 subacuminate, the inner 2 prominently subcaudate. *Stamens* 15, subequal, shorter than style at anthesis; filaments slender, tapering; anthers narrowly oblong; appendages slender, distinctly scarious, c.  $3 \times$  length of anther. *Ovary* ovoid, glabrous; style slender, filiform, obscurely trifid. *Fruit pedicel* to 2 mm long, slender, base of fruit obtuse; *3 longer calyx lobes* to 7.5 by 1 cm, spatulate, obtuse, tapering to c. 5 mm broad above the c. 7 by 5 mm elliptic saccate thickened base; 2 shorter lobes to 4 by 0.3 cm, linear, similar at base. *Nut* to 8 by 5 mm, ovoid, apiculate.

Distr. *Malesia*: Sumatra (Barisan Range from Toba to Musi Ulu, and down West coast; also Kuantan Distr. in east; Pulau Musala, Pulau Sitam-barat).

Ecol. Scattered, rarely common, in lowland coastal and hill forests to 1000 m.

Vern. *Damar mērilem, mērilem, marilem* (Tapanuli), *d. mansarai, mansarai, bēlamsarai* (Tapanuli, Padang), *serga, s. gunong* (Panobasan), *měranti saga, saga, damar saga, banio sapek, b. rawan, d. puteh* (W. coast).

**88. *Shorea cordata*** ASHTON, Gard. Bull. Sing. 22 (1967) 285, pl. 31; Man. Dipt. Brun. Suppl. (1968) 93. f. 12.

Large tree. Young twig and petiole densely caducous puberulent; leaf nervation beneath sparsely so, bud persistently so, stipule outside sparsely persistently so. *Twig* c. 3 by 2 mm  $\varnothing$  apically, somewhat

compressed, becoming terete, smooth to rugulose; stipule scars horizontal, broad, pale, prominent. *Bud* to 7 by 4 mm, ellipsoid, compressed, acute. *Stipule* to 12 by 6 mm, elliptic, obtuse. *Leaves* 8–15 by 5.5–10.5 cm, oblong to obovate; base typically cordate, sometimes obtuse; apex obtuse, retuse or abruptly to 8 mm long acuminate; nerves 15–18 pairs, prominent beneath, at 30°–40°; tertiary nerves slender, densely scalariform, set diagonally to nerves; midrib depressed above, prominent beneath; *petiole* 12–25 mm long, terete, frequently rugulose. *Panicle* to 12 cm long, terminal or axillary, lax, compressed or ribbed; singly branched, branchlets to 5 cm long, bearing to 5 ± secund flowers; *bracts* to 10 by 3 mm, lanceolate, acute, puberulent, fugaceous; *bracteoles* to 10 by 5 mm, elliptic, obtuse, not at first caducous. *Flower bud* to 10 by 5 mm, fusiform. *Calyx* sericeous outside, glabrous within; lobes narrowly deltoid-lanceolate, narrowly obtuse, the 3 outer somewhat longer than the 2 inner. *Petals* oblong-lanceolate, sericeous outside, glabrous within. *Stamens* 15, in 3 unequal verticils or with the outer vestigial and devoid of anthers; filaments longer than anther, narrow, compressed, tapering; anthers elliptic-oblong; appendage to connective to 6 times as long as anther, filiform, tapering somewhat shorter than style apex. *Ovary* ovoid, glabrous; style columnar, c. 2 × length of ovary, tapering, sericeous in the basal 1/3, obscurely trifurcate apically. *Fruit* glabrous. *Pedicel* obscure, tapering into the base of the fruit. 3 longer calyx lobes to 13 by 2.5 cm, lorate, obtuse, c. 8 mm broad above the c. 12 by 12 mm orbicular saccate thickened base; 2 shorter lobes to 6.5 by 0.8 cm, narrowly lanceolate, acute, similar at base. *Nut* to 14 by 10 mm, globose, closely and completely enveloped by the calyx; style remnant c. 4 mm long.

Distr. *Malesia*: Borneo (West Borneo to Central Sarawak).

Ecol. Rare, fertile soils on igneous rocks.

**89. *Shorea bracteolata*** DYER, Fl. Br. Ind. 1 (1874) 305; KING, J. R. As. Soc. Beng. Sec. 62, 2 (1893) 117; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 264; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 85; BURK, J. Str. Br. R. As. Soc. 76 (1917) 164, fig.; *ibid.* 81 (1920) 73, fig.; Gard. Bull. S. S. 3 (1923) 36; RIDL, Fl. Mal. Pen. 1 (1922) 229; BAKER f. J. Bot. 62, Suppl. (1924) 10; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 260; HEYNE, Nutt. Pl. ed. 2 (1927) 1115; FOXW. Mal. For. Rec. 1 (1921) 80; *ibid.* 3 (1927) 28, 3 pl.; *ibid.* 10 (1932) 183, pl. 1 (root syst. seedling); SLOOT, in Merr. Pl. Elm. Born. (1929) 202; EDWARDS, Mal. For. Rec. 9 (1931) 141; BURK, Dict. (1935) 2007; DESCH, Mal. For. Rec. 12 (1936) 27; *ibid.* 14 (1941) 16; SYM, Mal. For. Rec. 16 (1943) 34, f. 18, 19, 21; SLOOT, Bull. Jard. Bot. Btzg III, 18 (1949) 259, f. 13; BROWNE, For. Trees Sarawak & Brunei (1955) 158; ASHTON, Man. Dipt. Brun. (1964) 163, f. 15; *ibid.* Suppl. (1968) 93; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 53, f. 1a. — *S. foveolata* SCORT. ex FOXW. Mal. For. Rec. 10 (1932) 183, *nomen in syn.*

Medium-sized to large tree. All parts at first sparsely pale brown pubescent, surfaces covered with a scurfy waxy deposit; becoming glabrous except for the pubescent bud and panicle. *Twig* to 2 mm Ø apically, somewhat compressed, becoming smooth, glabrous; stipule scars short, inconspicuous. *Bud* 3–5 by 2 mm, shortly falcate, compressed, subacute. *Stipule* c. 1 cm long, linear, fugaceous. *Leaf* 9–14 by 4–6 cm, oblong-ovate to elliptic, ± thinly coriaceous; base obtuse; acumen 8–15 mm long; nerves 12–15 pairs, slender, curved, at c. 60°–70°; tertiary nerves distant, scalariform to subreticulate; *petiole* 1–2 cm long, slender. *Panicle* to 10 cm long, terminal or axillary, slender, terete, straight, usually singly branched; *bracteoles* to 12 by 5 mm, lanceolate, sparsely pubescent. *Flower bud* to 10 by 5 mm, ellipsoid, obtuse. *Calyx* densely pubescent outside, sparsely so within; 3 outer lobes broadly ovate-hastate, obtuse; 2 inner lobes narrowly ovate, acuminate, slightly shorter, thinner. *Petals* pale yellow tinged pink at base within, large, oblong-lanceolate, obtuse, shortly pubescent on parts exposed in bud. *Stamens* 15, the inner 5 somewhat longer than the outer 10; filaments broad, compressed at base, tapering gradually and filiform distally; anthers narrowly oblong; appendage to connective 3–4 × length of anther, slender, scabrous. *Ovary* ovoid, sparsely pubescent towards apex; style c. 2 × length of ovary, distinctly trifid towards apex. *Fruit calyx* puberulent, ± glabrescent; 3 longer lobes to 10 by 1.7 cm, spatulate, obtuse, to 4–5 mm broad above the c. 10 by 7 mm thickened saccate base; 2 shorter lobes 5–8 by 0.7 cm, unequal and sometimes almost as long as the larger lobes, spatulate, obtuse, similar at base. *Nut* c. 2 by 1 cm, narrowly ovoid; style remnant to 4 mm long, acute, short.

Distr. *Malesia*: Malaya, Singapore, Sumatra (excluding Atjeh), Borneo.

Ecol. Coastal hills and undulating land, in valleys occasionally to 600 m; on deep well drained soils.

Vern. *Mèranti pa'ang*, *m. kètapak*, *m. sègor*, *mèluit*, *mèmbantai*, *sama rupa mèranti*, *sèpa pètoi*, *tèmak* (Mal.), *kèdontang*, *k. abang*, *mèranti kasih*, *m. kunyit*, *m. kèpala*, *manisan* (Sumatra), *lampong bahei*, *l. mit*, *l. mèrahan*, *bènyau* (S.E. Borneo).

Note. A widespread and variable species.

**90. *Shorea resinosa*** FOXW. Mal. For. Rec. 10 (1932) 234, pl. 19; BURK, Dict. (1935) 2021; SYM, Mal. For. Rec. 16 (1943) 40, f. 19, 24; ASHTON, Man. Dipt. Brun. Suppl. (1968) 94, f. 12.

Large tree. Young twigs, buds, stipules outside and petioles shortly buff fugaceous puberulent. *Twig* c. 2 mm Ø apically, terete, smooth; stipule scars short, horizontal, obscure. *Bud* to 3 by 2 mm, ellipsoid, obtuse. *Stipule* to 12 by 8 mm, elliptic obtuse. *Leaves* 6.5–13 by 3.5–7 cm, lanceolate to elliptic, undulate; base narrowly to broadly cuneate; acumen to 12 mm long, slender; nerves 10–13 pairs, slender but prominent beneath, at 40°–50°; tertiary nerves slender, scalariform, at c. 90° to the nerves; midrib depressed above, prominent beneath; *petiole* 9–17 mm long,



drying rugose. *Panicle* to 8 cm long, terminal or axillary, terete, caducous puberulent, singly branched. Flower bud to 12 by 4 mm, fusiform. *Calyx* glabrous; 3 outer lobes narrowly lanceolate, acute; 2 inner somewhat shorter, broader. *Petals* pale yellow, lorate, obtuse, puberulent on parts exposed in bud. *Stamens* 15, in 2 unequal verticils; filaments compressed at base, tapering; anthers narrowly oblong; appendage to connective *c.*  $2\frac{1}{2} \times$  length of anthers, filiform, slender, glabrous. *Ovary* ovoid, glabrous, surmounted by a long slender glabrous style *c.*  $3 \times$  length of ovary; style trifid towards apex. *Fruit* glabrous. *Pedice*l to 4 mm long, *c.* 3 mm  $\varnothing$ , terminating abruptly at the obtuse base of the fruit. 3 longer *calyx lobes* to 9.5 by 2.5 cm, spatulate, obtuse, *c.* 7 mm broad above the to 14 by 14 mm subglobose saccate thickened base; 2 shorter lobes to 7 by 0.6 cm, linear, similar at base. *Nut* to 1.5 by 1.5 cm, ovoid; style remnant to 6 mm long, persistent, frequently lustrous with a film of resin.

Distr. *Malesia*: Malaya, Central Sumatra (Indragiri, sterile coll.), Borneo (W. Sarawak).

Ecol. Scattered on undulating land or hills to 500 m.

Vern. *Mēranti bēlang, lemesa, sama rupa mēranti* (Mal.).

**91. *Shorea agamii*** ASHTON, Gard. Bull. Sing. 19 (1962) 270, pl. 9. — *S. assamica ssp. philippinensis* (non SYM.) BROWNE, For. Trees Sarawak & Brunei (1955) 151.

**a. *ssp. agamii*** ASHTON, Man. Dipt. Brun. (1964) 161, f. 15, pl. 41 (stem-base, bark); *ibid.* Suppl. (1968) 93; Gard. Bull. Sing. 22 (1967) 285; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 51, f. 4.

Large tree. Young twig, panicle, bud, stipule, petiole and midrib beneath caducous pale brown pubescent. *Twig* 2–3 mm  $\varnothing$  at the apex, becoming smooth, terete; stipule scars short, inconspicuous. *Bud* *c.* 4 by 2.5 mm, ovoid to falcate, slightly pubescent or glabrous, obtuse. *Stipule* *c.* 10 by 3 mm, oblong, obtuse, shortly caducous pubescent outside, glabrous within. *Leaves* 10–15 by 6–10 cm, broadly ovate to oblong, coriaceous; base obtuse or subcordate; acumen 0.5–1 cm long, broad; nerves 9–13 pairs, well spaced, curved, at *c.* 90° at the leaf base, *c.* 40° at the apex; tertiary nerves densely scalariform, at 90° to nerves; *petiole* 1–1.5 cm long. *Panicle* 6–10 cm long, terminal or axillary, terete to angular apically; singly or doubly irregularly branched, branchlets short, bearing to 5 flowers; *bracts* fugaceous; *bracteoles* to 3 mm long, narrowly elliptic, subacute, shortly pale buff-tawny puberulent, caducous. *Flower bud* to 5 by 2.5 mm, small, narrowly ellipsoid, subacute. *Calyx* densely shortly pale yellowish buff pubescent; 3 outer lobes narrowly ovate, subacuminate; 2 inner lobes  $\frac{2}{3}$  as long, narrow, prominently caudate. *Petals* small, ovate-elliptic, acute, densely pubescent on parts exposed in bud, puberulent elsewhere on outer surface. *Stamens* 15 in 3 subequal verticils; filaments  $\pm$

same length as anthers, rather narrow, tapering; anthers oblong, somewhat tapering; appendage to connective *c.* 3 times length of anther, slender, extending to style apex. *Ovary* ovoid, densely pubescent; style slightly longer than the ovary, sparsely pubescent in the basal half, glabrous distally, stoutly filiform, tapering, obscurely trifurcate. *Fruit calyx* shortly fugaceous pubescent; 3 longer lobes 10–12 by 1.5–2.2 cm, spatulate, obtuse, tapering to 5 mm broad above the 1–1.5 cm broad strongly saccate thickened base; 2 shorter lobes to 6 by 0.4 cm, linear, unequal, similar at base. *Nut* to 2 by 1.5 cm, ovoid, glabrescent; style remnant 3–4 mm long, acute; base of fruit impressed at the short pedicel.

Distr. *Malesia*: Borneo (Bintulu north-eastwards to Sabah and Tidung).

Ecol. Leached soils on undulating land and shale hills below 700 m.

Vern. *Mēranti puteh timbul* (Brun.), *mēlapi agama* (Sabah).

**b. *ssp. diminuta*** ASHTON, Gard. Bull. Sing. 22 (1967) 285, pl. 30; Man. Dipt. Brun. Suppl. (1968) 93.

Leaf 4.5–10 by 2.5–4 cm, narrowly ovate.

Distr. *Malesia*: Borneo (W. Sarawak, Kapuas and Rejang hinterlands, Muara Tewe).

Ecol. As *ssp. agamii*.

**92. *Shorea confusa*** ASHTON, Gard. Bull. Sing. 31 (1978) 44. — *S. virescens* (non PARIJS) ASHTON, Man. Dipt. Brun. (1964) 167; *ibid.* Suppl. (1968) 95; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 60, f. 6.

Large tree. Leaf bud, panicle, stipule outside, petiole, and very young twig caducous pubescent. *Twig* 2–3.5 mm  $\varnothing$  apically, frequently rugulose; stipule scar short, obscure. *Bud* 3–4 by 2 mm, conical, acute. *Stipule* *c.* 8 by 3 mm, linear to deltoid, subacute. *Leaves* 6–12 by 3.5–3 cm, elliptic to slightly obovate; base obtuse; acumen broad, 0.5–1.0 cm long; nerves (10–)13–18 pairs, curved, at 90° at the base, *c.* 40° at the apex; tertiary nerves densely scalariform, at 90° to nerves; *petiole* 1–1.5 cm long, *c.* 1 mm  $\varnothing$ , rather slender. *Panicle* to 22 cm long, terminal or axillary, terete, lax; singly or doubly branched, branchlets to 10 cm long, bearing to 6 flowers; bracts and bracteoles unknown. *Flower bud* to 9 by 5 mm, narrowly ovoid, obtuse. *Calyx* puberulent outside, glabrous within; lobes equal, narrowly deltoid, obtuse. *Petals* large, narrowly ovate, acute, puberulent on parts exposed in bud. *Stamens* 15, in 3 subequal verticils; filaments *c.*  $1\frac{1}{2} \times$  length of anther, slender, tapering gradually; anthers oblong, tapering; appendage to connective *c.*  $3 \times$  length of anther, reaching  $\frac{2}{3}$  length of style. *Ovary* small, ovoid, puberulent; style stoutly filiform, *c.*  $3 \times$  length of ovary, glabrous in the apical  $\frac{1}{3}$ , otherwise puberulent, shallowly trifurcate. *Fruit pedicel* stout. *Calyx* glabrous; 3 longer lobes to 12 by 1.5 cm, narrowly spatulate, obtuse, hardly tapering, slightly broadening at the thickened saccate base; 2 shorter lobes to 6 by 0.5 cm, unequal, linear, similar at base; base of calyx obconical, tapering into the pedicel. *Nut*

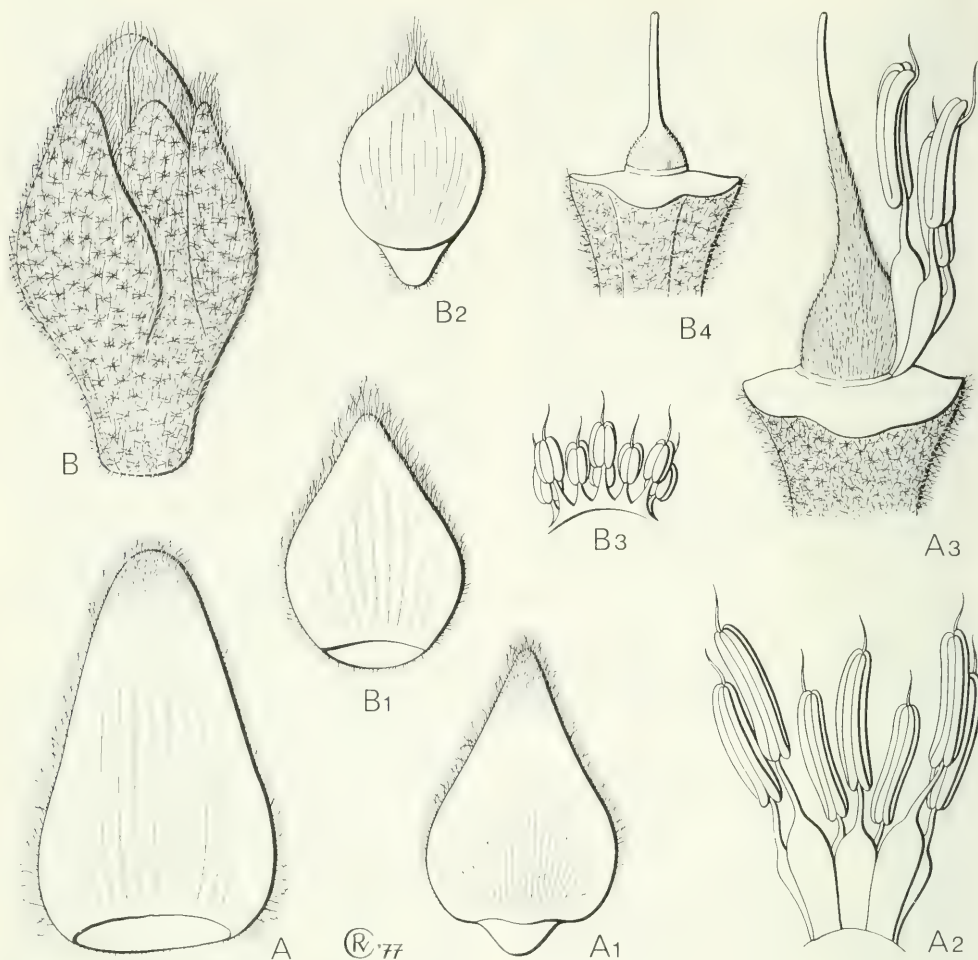


Fig. 94. Flower details in *Shorea* sect. *Rubella* ASHTON. All  $\times 10$ . Sepals drawn from inside. — *S. albida* SYM. A. Outer sepal, A1. inner sepal, A2. stamens from inside, A3. stamens and pistil. — *S. elliptica* BURCK. B. Bud, B1. outer sepal, B2. inner sepal, B3. stamens from inside, B4. pistil (A TAHIR 12250, B ROSLI & ASAH 3373).

to 2 cm long, ovoid, glabrescent; style remnant c. 6 mm long, slender.

Distr. *Malesia*: N.E. Borneo (N.E. Sarawak, Sabah S.E. to Sangkulirang).

Ecol. Scattered, undulating land and hills below 650 m, on leached clay soils in Mixed Dipterocarp forest.

Vern. *Meranti sulang salang*.

## 6. Section *Rubella*

ASHTON, Gard. Bull. Sing. 20 (1963) 267; Man. Dipt. Brun. (1964) 117. — **Fig. 94, 95.**

*Flower buds* medium size, fusiform. *Petals* generally cream suffused with pink, lanceolate, contorted and imbricate at base forming a goblet enclosing the



anthers, connate on falling. *Stamens* 15–50; filaments lorate, long, tapering gradually or abruptly below the anthers; anthers with 4 glabrous linear-oblong pollen sacs; appendage to connective short or to  $\frac{3}{4}$  length of the pollen sacs, becoming  $\pm$  reflexed at anthesis, glabrous. *Ovary* with or without distinct stylopodium. *Leaf* white lepidote beneath, with scalariform tertiary nerves; midrib above evident or obscure (*S. albida*). Large stoutly buttressed trees. *Bark surface* prominently V-section fissured. *Wood* red, without silica deposits; vessels solitary or in small clusters.

Distr. *Malesia*: Philippines, northern Borneo.

Ecol. Lowland evergreen forests, scattered or gregarious (*S. negrosensis*, *S. albida*).

Note. The androecium and gynoecium characters in most respects resemble those of *sect. Anthoshorea*. WHITMORE (Gard. Bull. Sing. 19, 1962, 2) has shown that the bark anatomy of *S. albida* also in most respects conforms with that section. The wood anatomy conforms by contrast entirely with SYMINGTON's (Mal. For. Rec. 16, 1943, 58) and DESCH's (*ibid.* 14, 1941, 34) Red Meranti Group.

**93. *Shorea albida* SYM.** [*ex* THOMAS, Mal. For. 3 (1934) 147, *nomen*] Gard. Bull. S. S. 8 (1935) 283, pl. 26; BROWNE, For. Trees Sarawak & Brunei (1955) 137; ANDERSON, Gard. Bull. Sing. 20 (1963) 158; ASHTON, Man. Dipt. Brun. (1964) 175, f. 19, pl. 42 (stem), 43 (stand), 44 (stand in swamp); *ibid.* Suppl. (1968) 104; BRÜNIG, Commonw. For. Rev. 52 (1973) 260. — **Fig. 8, 94 A–A3, 96, 97.**

Small, medium-sized or vast buttressed tree. *Twig*, leaf bud, stipule, petiole and leaf nervation beneath shortly densely persistently red-brown puberulent; leaf beneath cream lepidote. *Twig* to 5 by 2 mm  $\varnothing$  apically, compressed, becoming smooth; stipule scars short, straight, thin. *Bud* to 10 by 6 mm, ovoid to hastate, compressed, acute. *Stipules* to 20 by 8 mm, oblong, obtuse. *Leaves* 7.5–15 by 4.5–6.5 cm, oblong-elliptic, coriaceous; base obtuse; acumen to 6 mm long, broad; nerves 16–20 pairs, slender, hardly raised beneath, at 55°–70°, with shorter intermediates; tertiary nerves slender, densely scalariform, diagonal to nerves; midrib prominent beneath, obscure and depressed above; *petiole* 2–3.5 cm long. *Panicle* to 18 cm long, terminal or axillary, compressed, shortly densely cream puberulent; doubly branched, branchlets bearing to 3 flowers; *bracteoles* to 8 by 3 mm, lanceolate, acute, densely pubescent outside, glabrous within. *Bud* to 9 by 5 mm, broadly ellipsoid, acute. *Calyx* densely puberulent outside, glabrous within; 3 outer lobes deltoid, obtuse; 2 inner shorter, deltoid, acuminate. *Petals* cream, ovate, obtuse, pubescent on parts exposed in bud. *Stamens* 20–25, of variable length, the inner 5 somewhat longer than the others; filament broad at base, tapering and filiform distally; anther narrowly oblong, longer than the filament; appendage to connective short, slender, erect, less than  $\frac{1}{2}$  length of anther. *Ovary* ovoid, shortly pubescent; style twice length of ovary, densely pubescent in basal half. *Fruit calyx* persistently sparsely pubescent at base, glabrescent elsewhere; 3 longer lobes to 8 by 1.4 cm, narrowly spatulate, obtuse, to 4 mm broad above the to 7 by 7 mm suborbicular thickened saccate base. *Nut* to 12 by 9 mm, ovoid, densely greyish buff pubescent; style remnant to 2 mm long.

Distr. *Malesia*: N.W. Borneo (Kapas swamps through Sarawak to the Limbang Valley).

Ecol. Local on podsols on terraces and plateaux in Heath forest to 1200 m. Gregarious and dominant on oligotrophic peat swamps except at the margin and sometimes centre.

The peat swamp forests where *S. albida* occurs can be classified into a succession of concentric 'phasic' communities according to the performance of this and other dominant species (ANDERSON, 1963): 1. A mixed species forest at the periphery lacking *S. albida*. 2. With *S. albida* dominant and sometimes reaching 6.5 m tall, but forming an incomplete heterogeneous canopy and rarely successfully regenerating. 3. With *S. albida* forming a complete even canopy, regenerating patchily and becoming smaller towards the centre. 4. With *Litsea palustris* a dominant or codominant, forming an even canopy but not exceeding 40 m tall. Here regeneration is abundant though largely through coppicing.

*S. albida* does not occur in the innermost communities. Lightning and wind damage form conspicuous gaps in the even canopy of phasic community (BRÜNIG, 1973), but mortality over much greater areas, in large sharply defined patches totalling thousands of hectares in all, is attributed to an unidentified moth larva, belonging to the Himantidae (*cf.* Imp. For. Rev. 40, 1961, 19).

Uses. The largest trees, towards the margins of the swamps, are all hollow and are very hard wooded; those towards the centre are too small and the wood is soft; trees in the intermediate zone are an important source of red meranti timber.

Vern. *Alan* (Sar.), *sëringawan* (Brun.).

Note. The vegetative parts are strikingly similar to those of *S. balangeran* in *sect. Brachypterae*, which shows an apparently identical ecological range and replaces it in Indonesian Borneo. The stamens at once distinguish these species, but the presence of abnormal stamens of the *S. balangeran* type in the flowers examined by SYMINGTON suggests that the affinity is genuine. The obscure midrib above and slender nerves distinguish *S. albida* from other species in this section

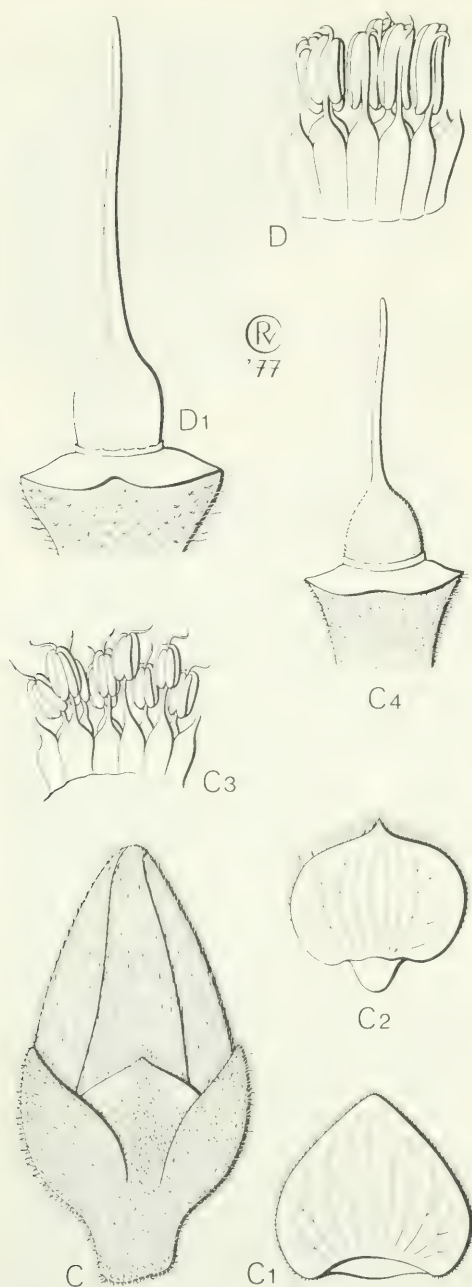


Fig. 95. Flower details in *Shorea* sect. *Rubella* ASHTON. All  $\times 10$ . Sepals drawn from inside. — *S. dispar* ASHTON. C. Bud, C1. outer sepal, C2. inner sepal, C3. stamens from inside, C4. pistil. — *S. rubella* ASHTON. D. Stamens, from outside, D1. pistil (C S 29208, D BRUN 3078).

and evoke *S. coriacea* and its allies in sect. *Brachypterae*, as well as sect. *Anthoshorea* generally.

**94. *Shorea rubella*** ASHTON, Gard. Bull. Sing. 19 (1962) 307, pl. 27; Man. Dipt. Brun. (1964) 216, f. 19, pl. 57 (habit & bark); *ibid.* Suppl. (1968) 118; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 143. — **Fig. 1, 95 D–D1.**

Medium-sized to large tree. Young parts evenly shortly pale cream to pink-buff pubescent, persistent only on panicle, bud and stipule. Twig 2–3 mm  $\varnothing$  at apices, ridged and compressed apically on drying, becoming terete, smooth, stout; stipule scars c. 1.5 mm long at first,  $\pm$  horizontal, narrowly cuneate. Bud 6–9 by 2–3 mm, narrowly ovoid or slightly falcate. Stipule to 18 by 6 mm, hastate to falcate, acute. Leaves 9.5–14 by 6–8 cm, broadly ovate, thickly coriaceous, cream lepidote beneath; base obtuse; acumens to 1 cm long; margin sometimes slightly revolute; nerves 5–7 pairs, prominent beneath, curved, well spaced, at c. 45°–60°, with or without minute axillary domatia; tertiary nerves at c. 90°, slender, densely scalariform; midrib appanate on upper surface or slightly depressed. Petiole 2.3–3.5 cm long. Panicles to 15 cm long, terminal or axillary, ribbed on drying; singly or doubly branched, branchlets to 5 cm long, lax, bearing to 5 distichous flowers; bracts and bracteoles unknown. Flower bud to 7 by 3 mm, narrowly ovoid, acute. Calyx shortly densely pale pink-grey pubescent outside, glabrous within; lobes ovate, subequal, the inner 2 slightly broader and shorter than the outer 3. Petals pale pink, darkening towards base, oblong, obtuse, only slightly contorted, hardly adhering on falling, shortly pubescent on parts exposed in bud. Stamens 15, closely congested round the ovary and style, subequal; filaments reaching the ovary apex, lorate, abruptly tapering apically; anther as long as filament, narrowly oblong; appendage to connective short, stout, becoming slightly recurved. Ovary small, globose, glabrous; stylopodium indistinct; style 3 times as long as ovary, glabrous, filiform. Fruit calyx subglabrous; 3 longer lobes to 8 by 1.5 cm, spatulate, obtuse, with to 10 by 7 mm ovate saccate thickened base; 2 shorter lobes to 5 by 0.6 cm, linear, similar at base. Nut to 18 by 12 mm, ovoid, densely buff pubescent, acute.

Distr. *Malesia*: Borneo (Rejang valley to S.W. Sabah).

Ecol. Local on deep yellow sandy soils on coastal hills below 400 m.

**95. *Shorea elliptica*** BURCK, Ann. Jard. Bot. Btzig 6 (1887) 215; BRANDIS J. Linn. Soc. Bot. 31 (1895) 99; MERR. En. Born. (1921) 404; BROWNE, For. Trees Sarawak & Brunei (1955) 138; ASHTON, Man. Dipt. Brun. Suppl. (1968) 151, f. 13, pl. 20 (bark). — **Fig. 94 B–B4.**

Medium-sized tree. Twig, bud, stipule outside, nerves and midrib beneath densely scabrid ocherous to cream pubescent; midrib above evenly so; nerves above and stipule within sparsely evenly so; leaf





Fig. 96. *Shorea albida* SYM., alan-forest, centre of peat swamp. Brunei (Photogr. ASHTON).

undersurface densely cream lepidote. *Twig* c. 2 mm  $\varnothing$  apically, much branched, terete to subcompressed, smooth or rugulose; stipule scars short, horizontal. *Bud* to 8 by 6 mm, ovoid, obtuse, compressed. *Stipule* to 10 by 6 mm, narrowly ovate, acute, caducous. *Leaves* 7–10 by 4–9 cm, elliptic to oblong, thickly coriaceous; base broadly cuneate to subcordate; apex obtuse or shortly broadly acuminate; nerves 11–16 pairs, prominent beneath, at 75° at base, 45°–55° towards the apex; tertiary nerves slender, densely scalariform, at c. 90° to the midrib; midrib shallowly depressed above, prominent beneath; *petiole* 1.5–3.3 cm long, terete, rugose distally. *Panicle* to 12 cm long, terminal or axillary,  $\pm$  compressed at first, becoming terete, densely persistently ocherous scabrid pubescent; singly or doubly branched, branchlets to 2 cm long, bearing to 3  $\pm$  distichous flowers; *bracteoles* to 2

by 1 mm, small, elliptic, obtuse, pubescent, caducous. *Flower bud* to 4 by 3 mm, narrowly ovoid. *Sepals* pubescent on parts exposed in bud, ovate, acute, the inner 2 relatively shorter, narrower than the outer 3. *Petals* pale yellow, pubescent on parts exposed in bud, narrowly oblong. *Stamens* 19–20; filaments compressed, slender, somewhat tapering; anthers oblong, almost as long as filaments, crowned by a short relatively stout glabrous appendage somewhat shorter than the anthers. *Ovary* ovoid, glabrous; style filiform, c. 2 times as long as ovary, trifid at apex, glabrous. *Fruit pedicel* to 3 mm long, swelling into the base of the fruit. *Calyx* sparsely shortly pubescent; 3 longer lobes to 8 by 1.5 cm, narrowly spatulate to suborbate, obtuse, c. 4 mm broad above the to 10 by 6 mm elliptic saccate  $\pm$  thickened base. *Nut* to 15 by 12 mm, ovoid, acute, densely evenly buff pubescent.



Fig. 97. Trunk of *Shorea albida* SYM. Brunei (Photogr. ASHTON).

Distr. *Malesia*: Borneo (N.W. Kalimantan, W. Sarawak).

Ecol. Local, leached soils in Mixed Dipterocarp forest below 500 m.

Vern. *Mēranti lang* (Sar.).

**96. *Shorea dispar* ASHTON**, Gard. Bull. Sing. 31 (1978) 45. — Fig. 95 C–C4.

Large buttressed tree. Twigs, petioles, bud, panicles, perianth outside and ovary densely  $\pm$  persistently pale tawny pubescent, leaf nervation beneath sparsely so. Twigs *c.* 2 mm  $\varnothing$  apically, much branched, terete, at first rugulose and  $\pm$  ribbed, becoming smooth, dark brown dappled; stipule scars short, dark, horizontal. Buds to 3 by 2 mm, ellipsoid, obtuse. Stipules unknown. Leaves 4–7 by 2–3.5 cm, elliptic, coriaceous,  $\pm$  distinctly but sparsely cream lepidote beneath; margin subrevolute; base cuneate; acumen short, broad; nerves 9–11 pairs, ascending, prominent beneath, obscure and narrowly depressed above as also the midrib; petiole 12–16 mm long. Panicles to 8 cm long, terminal or axillary, rigid, ascending; singly

or doubly branched, branchlets to 3 cm long. Flower buds to 6 by 4 mm, long, ovoid. Sepals broadly ovate, subequal, shortly subacuminate. Stamens *c.* 25; filaments long, lorate, somewhat tapering to the oblong anthers; appendages *c.*  $\frac{3}{4}$  length of anthers, slender, tapering, glabrous, becoming  $\pm$  reflexed at anthesis; ovary small, ovoid, glabrous, surmounted by a slender filiform style *c.* twice its height. Fruit unknown.

Distr. *Malesia*: Borneo (Central Sarawak; once collected).

Ecol. Mixed Dipterocarp forest on inland hills.

Note. Superficially resembling *S. parvifolia* DYER *ssp. velutinata* ASHTON; the flowers betray the close relationship of this rare tree with red lauan, *S. negrosensis* FOXW., the celebrated timber tree of the Philippines, and assign both to *sect. Rubella* ASHTON.

**97. *Shorea negrosensis* FOXW.** Philip. J. Sc. 6 (1911) Bot. 274, pl. 44; *ibid.* 13 (1918) Bot. 192; *ibid.* 67 (1938) 315; MERR. En. Philip. 3 (1923) 97; REYES, Philip. J. Sc. 22 (1923) 327.

Large buttressed tree. Twigs, buds, stipules, midrib above, panicles, parts of petals exposed in bud and ovary densely persistently yellow-brown pubescent; petiole, leaf beneath and calyx sparsely so; bracteoles puberulent. Twig *c.* 2 mm  $\varnothing$  apically, terete, becoming smooth; stipule scars short, obscure. Buds to 2 by 1 mm, conical; stipules to 15 by 4 mm, lanceolate, acute. Leaves 6.5–17 by 3–7.5 cm, ovate to elliptic, thinly coriaceous; base cuneate to obtuse, frequently unequal; acumen to 2 cm long, slender, prominent, tapering; nerves (8–)11–15 pairs, slender but prominent beneath, arched, at 60°–70°, frequently with small tomentose axillary domatia; tertiary nerves scalariform, elevated beneath; midrib prominent beneath, evident but shallowly depressed above; petiole 18–25 mm long, slender but geniculate. Panicle to 14 cm long, slender; singly branched, branchlets to 15 mm long, rather short, bearing to 4 second flowers; bracteoles to 4 by 3 mm, ovate, obtuse, caducous. Flower bud to 7 by 4 mm, broadly ellipsoid; sepals ovate, the outer 3 acute, the inner 2 acuminate; stamens *c.* 48, subequal, exceeding style at anthesis; filaments very long and slender, lorate, slightly tapering; anthers linear-oblong; appendages to 1/8 length of anther but usually much shorter, slender, glabrous; ovary ovoid, puberulent; style shorter than ovary, columnar, glabrous. Mature fruit unknown. Fruit subsessile; 3 longer calyx lobes *c.* 7 by 1.3 cm, spatulate, obtuse, *c.* 9 mm broad above the 10 by 10 mm suborbicular thickened saccate base; 2 shorter lobes to 30 by 4 mm, linear-lorate, acute, similar at base; nut ovoid, apiculate.

Distr. *Malesia*: Philippines.

Ecol. Widespread, common and often gregarious, in Evergreen and Semi-evergreen  $\pm$  seasonal Dipterocarp forests in lowlands.

Vern. *Red lauan*, *mangachapuy*.

Note. Some sterile collections, apparently of this species, bear significantly smaller leaves; flowering material is needed to establish their identity.



7. Section *Brachypterae*

HEIM, Rech. Dipt. (1892) 46; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 76, *p.p.*; ASHTON, Gard. Bull. Sing. 20 (1963) 270; Man. Dipt. Brun. (1964) 117. — *Shorea*, *Red Meranti* group, *S. pauciflora* subgroup SYM. Mal. For. Rec. 16 (1943) 58. — **Fig. 91 D, 98–100.**

Flower buds  $\pm$  ovoid. Corolla as in *sect. Rubella*. Filament broad and compressed at base, tapering  $\pm$  abruptly medially and filiform below anthers; anthers 4-celled, subglobose or broadly oblong; appendage to connective aristate,  $1\frac{1}{2}$ – $3\frac{1}{2}$  times length of anthers. Ovary with distinct stylopodium: ovary and stylopodium  $\pm$  pyriform; or without distinct stylopodium but with style frequently pubescent towards base. Panicle lax, branchlets long. Stipules and bracteoles sometimes somewhat persistent. Leaf with scalariform tertiary nerves; midrib evident, elevated, or obscurely depressed above. Vessels solitary or in small groups; ray cells without silica. Medium-sized or large stoutly prominently buttressed trees.

Distr. Non-seasonal western *Malesia* including the Philippines; one species in the Moluccas.

Ecol. Scattered in lowland forests and on mountain ridges (*S. venulosa*, *S. monticola*) to 1800 m; a few species (*S. balangeran*, *S. selanica*) are gregarious, even forming pure stands.

Vern. *Red mēranti*, *mēranti merah* (Mal., Sum.), *mērawan* (Iban), *red lauan* (Philippines).

Note. The floral morphology is closely similar to the pattern of *sect. Anthoshorea*, making assignment difficult without anatomical investigation. With the notable exception of *S. parvistipulata* and the clearly closely related short-sepalled *S. fallax*, species in this section are well defined; though several, e.g., *S. pauciflora*, *S. johorensis*, *S. almon*, and *S. kunstleri* do exhibit some local variation.

7a. Subsection *Smithiana*

ASHTON, Gard. Bull. Sing. 20 (1963) 270; Man. Dipt. Brun. (1964) 118. — **Fig. 98.**

Stamens 22–26. Style very short, ovary with prominent columnar stylopodium. Bark surface with deep V-section fissures, inflaked, as in *sect. Mutica* but with sheet-like rhytidome layers as in *sect. subsect. Brachypterae* and other flaky-barked groups.

**98. *Shorea smithiana*** SYM. Gard. Bull. S. S. 9 (1938) 345, pl. 26; ASHTON, Man. Dipt. Brun. (1964) 223, f. 17; *ibid.* Suppl. (1968) 119; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 148, pl. 10 (habit), f. 16. — *Shorea* sp. (ELMER 21606) SLOOT. ex MERR. Pl. Elm. Born. (1929) 205. — **Fig. 98.**

Large buttressed tree. Young twig, leaf bud, stipule outside (puberulent within), petiole, leaf beneath, midrib above and panicle persistently grey-brown to rust scabrid tomentose, leaf above caducous puberulent. Twig 3–4 mm  $\varnothing$  apically, stout, ribbed, smooth, glabrous; stipule scars to 2 mm long at first, broad, falcate, descending. Bud 5–8 by 3–4.5 mm, ovoid, slightly compressed. Stipule to 20 by 6 mm, broadly hastate, subacute. Leaves 12–20 by 6.5–11.5 cm, broadly obovate to oblong or ovate, grey lepidote beneath, coriaceous; base obtuse or subcordate; acumen to 1.5 cm long, broad; nerves 14–17 pairs, prominent beneath, curved, at 50°–60° distally, more spreading at base; tertiary nerves scalariform, well

spaced, sinuate; midrib prominent, stout, rounded, beneath, rather narrow and slightly depressed above; petiole 2.2–2.8 cm long, stout. Panicle to 25 cm long, terminal or axillary, terete, regularly singly branched, the branchlets bearing to 7 secund flowers; bracteoles to 5 by 4 mm, ovate, subacute, shortly pubescent on both surfaces, falling before the corolla opens. Flower bud to 10 by 3 mm, narrowly ovoid, subacute. Calyx densely pubescent outside, glabrescent within; lobes broadly deltoid to ovate, acute, subequal, the 2 inner the narrower. Petals pink, narrowly oblong, short, densely yellowish brown pubescent on parts exposed in bud. Stamens 22–26, of 3 sizes; filaments basally expanded, abruptly tapering and filiform distally; anthers broadly oblong; appendage to connective almost twice as long as anthers, reaching to  $\frac{3}{4}$  length of ovary and style, not reflexed. Ovary and stylopodium narrowly pyriform, puberulent; style cylindrical, glabrous. Fruit calyx glabrescent; 3 longer lobes to 20 by 2.8 cm, narrowly spatulate, coriaceous, narrowly

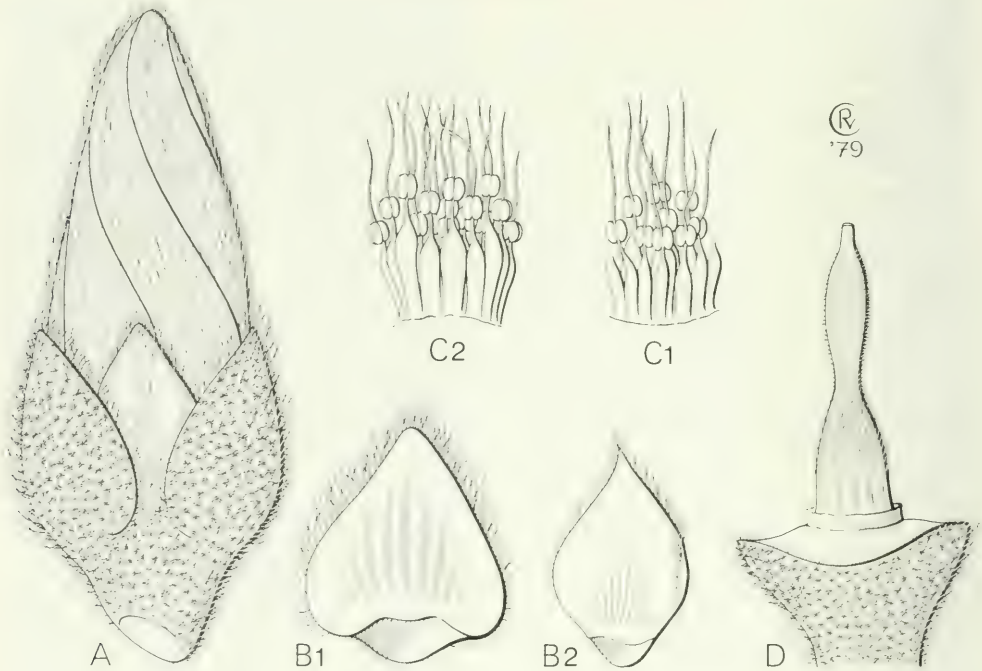


Fig. 98. Flower details in *Shorea* sect. *Brachypterae* HEIM subsect. *Smithiana* ASHTON. — *S. smithiana* SYM. A. Bud. B1. outer sepal. B2. inner sepal. C1. stamens from outside. C2. stamens from inside. D. pistil, all  $\times 10$  (bb. 34816).

obtuse, c. 1.3 cm broad and often slightly revolute above the to 1.5 by 1.8 cm broadly ovate shallowly saccate thickened base; 2 shorter lobes to 13 by 0.9 cm, linear, similarly expanded at base. *Nut* to 2.7 by 1.8 cm, ovoid; style remnant to 3.5 mm long, tapering, densely evenly shortly pale cream-buff pubescent.

Distr. *Malesia*: Eastern Borneo (N.E. Sarawak, Sabah, S.E. Borneo to Sampit).

Ecol. Frequent on deep sandy clay soils on undulating land and to 400 m.

Uses. One of the chief sources of light red meranti timber in N.E. Borneo.

Vern. *Chēmpaga* (Nunukan), *lempong mērēmbong*, *l. tembaga*, *awang* (Kutei), *mahambung* (Sampit), *sēraya timbau* (Sabah), *mēranti rambai*, *mēraka* belong (Brunei), *ēngkabang* (*mangkabang*), *rambai* (Iban), *bērat* (Murut).

#### 7b. Subsection *Brachypterae*

ASHTON, Gard. Bull. Sing. 20 (1963) 271. — *Shorea* sect. *Pachychlamys* DYER ex KING, J. As. Soc. Beng. Sc. 62, 2 (1893) 109. — *Pachychlamys* (DYER ex KING) DYER ex RIDL. Fl. Mal. Pen. 1 (1922) 233. — **Fig. 91D, 99–100.**

Stamens 15. Style generally as long as or longer than ovary. Bark surface square-section fissured, generally appearing flaky rather than fissured; phloem matrix proliferation tissue with pale stone cells in conspicuous simple laminae; phelloderm thin, inconspicuous.



**99. *Shorea inaequilateralis*** SYM. Gard. Bull. S. S. 8 (1935) 281, pl. 25; BROWNE, For. Trees Sarawak & Brunei (1955) 153; ANDERSON, Gard. Bull. Sing. 20 (1963) 158; ASHTON, Man. Dipt. Brun. (1964) 191, f. 17; *ibid.* Suppl. (1968) 109. — '*Semayor*' DURANT, Rep. For. Brunei (1933) 37, 42.

Large, buttressed, fissure-barked tree with pendent branches. Young parts shortly densely evenly pale tanny tomentose, persistent on young twig, panicle, leaf bud, outside of stipule, petiole and midrib above; persistently puberulent, appearing glabrous, on inside of stipule, lamina on both surfaces, and midrib beneath. *Twig* c. 2.5 by 1.5 mm  $\varnothing$  apically, slightly compressed at first, becoming terete with a decurrent rib below the petiole insertion each side, becoming glabrous, smooth; stipule scars to 1.5 mm long, narrowly falcate, descending, obscured by tomentum. *Bud* 3–6 by 1.5–2.5 mm, ovoid, slightly compressed, acute. *Stipule* to 20 by 5 mm, subpersistent, narrowly hastate, acute. *Leaves* 9–14 by 4.5–7.5 cm, ovate, thin; base subcordate, distinctly unequal; acumens to 2 cm long, prominent, caudate; nerves 11–13 pairs, slender, raised beneath, at more than 90° at base, ascending towards apex; tertiary nerves slender, scalariform, well spaced, at c. 90° to nerves; midrib narrow, prominent, rounded beneath, evident but appanate above; *petiole* 5–8 mm long, short, stout. *Panicle* to 7 cm long, terminal or axillary, terete, pendent; singly branched, branchlets to 1.5 cm long, bearing to 4 flowers; *bracteoles* to 10 by 3 mm, narrowly deltoid, pubescent outside, glabrescent within. *Flower bud* to 12 by 3 mm, linear, acute. *Calyx* densely shortly pubescent on both surfaces; 3 outer lobes deltoid, subacute; 2 inner lobes shorter, prominently acuminate. *Petals* narrowly hastate, subacute, sparsely pubescent on parts exposed in bud. *Stamens* 15, in 3 subequal verticils; filaments broad, compressed at base, tapering abruptly medially and filiform distally; anther oblong; appendage to connective c. 3 times length of anther, reaching  $\frac{1}{2}$  length of style, slender, erect, scabrous towards apex. *Ovary* ovoid, tapering, sparsely pubescent, without distinct stylopodium; style about twice length of ovary, filiform, sparsely pubescent in the basal half, otherwise glabrous. *Fruit calyx* glabrescent but for the sparsely tawny pubescent base; 3 longer lobes to 14 by 2 mm, elliptic saccate thickened base; 2 shorter lobes to 12 by 0.9 cm, long, narrowly spatulate, acute, to 4 mm broad above the to 13 by 9 cm, unequal, narrowly spatulate, similar at base. *Nut* to 1.8 by 1.4 cm, ovoid, densely buff pubescent; style remnant to 6 mm long, slender, subpersistent, filiform.

Distr. *Malesia*: N.W. Borneo (Sarawak, Brunei).

Ecol. Locally abundant in Mixed Peat Swamp forest.

Uses. A valuable heavy construction timber.

Vern. *Semayur* (Brun.).

Note. An isolated species apparently related to the following.

**100. *Shorea selanica*** BL. Mus. Bot. Lugd.-Bat. 2

(1852) 33, *incl. var. latifolia* BL.; WALP. Ann. 4 (1857) 338; DC. Prod. 16, 2 (1868) 629; HANCE, J. Bot. 14 (1876) 242; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 216, *incl. var. obtusa* BURCK; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 86; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 266; MERR. Int. Rumph. (1917) 375; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 306; *ibid.* ed. 2 (1927) 1124; SLOOT, Reinwardtia 2 (1952) 50, f. 16, 17. — *Dammara selanica* RUMPH. [Herb. Amb. 2 (1743) 168, t. 56] *ex* LAMK, Encycl. 2 (1786) 259, *inval.* — *Unona selanica* DC. Prod. 1 (1824) 92. — *Engelhardtia selanica* BL. Fl. Jav. 1 (1828) 8. — *Hopea selanica* W. & A. Prod. (1834) 85; HASSK. Cat. Hort. Bog. (1844) 209; WALP. Rep. 5 (1845) 128; MIQ. Fl. Ind. Bat. 1, 2 (1959) 504; DC. Prod. 16, 2 (1868) 635.

Vast buttressed tree. Young parts, twigs, buds, stipules, leaf undersurface, petiole, panicle, ovary and parts of petals exposed in bud densely persistently pale cream-brown pubescent; densely so at first on calyx, becoming sparsely so; young trees sparsely darker pubescent. *Twigs* 2–3 mm  $\varnothing$  apically, ribbed and sometimes compressed at first, becoming terete, smooth; stipule scars short, pale, horizontal. *Bud* c. 2 by 1 mm, ovoid, obtuse; *stipules* to 10 by 4 mm, lanceolate, acute,  $\pm$  fugaceous. *Leaves* (7)–9–18 by 3–7 cm (larger in immature trees), oblong-ovate, thinly coriaceous, cream below (mature trees); base obtuse to subcordate,  $\pm$  unequal, apex shortly acuminate; nerves 19–23 pairs, slender but prominent beneath,  $\pm$  appanate above, at c. 65°; tertiary nerves densely scalariform, hardly elevated beneath; midrib prominent beneath obscurely depressed above; *petiole* 8–12 mm long, slender. *Panicles* to 15 cm long, slender, somewhat lax, terminal or axillary; singly branched, branchlets to 3 cm long, bearing to 7 flowers. *Flower buds* to 6 by 3 mm, fusiform; *sepals* broadly ovate, the outer 3 acute, the inner 2 acuminate; *stamens* 15, unequal; filaments broadly compressed at base, tapering medially and filiform beneath the broadly ellipsoid anthers; appendages very slender, scarious near the apices, twice length of anthers; *ovary* ovoid, puberulent; style filiform, slender, twice length of ovary, glabrous. *Fruit pedicel* c. 1 mm long, slender; 3 longer *calyx lobes* to 10 by 1.5 cm, narrowly spatulate, obtuse, c. 5 mm wide above the 7 to 8 mm ovate saccate thickened base; 2 shorter lobes to 4.5 by 0.6 cm, linear, similar at base. *Nut* to 15 by 8 mm, ovoid, apiculate.

Distr. *Malesia*: Moluccas (Buru; Sula Is.: Mangole, Sanana; Obi Is.; Ambon).

Ecol. Gregarious and dominant in the Moluccan semi-evergreen lowland forests on well drained land with fertile soils, sometime overlying limestone.

Uses. The most valuable construction timber of the Moluccas.

Vern. *Kayo bapa* (Buru, Ambon, Sanana, Mangole), *sehu, boba* (Samuja), *luma, bahut, biahgawa* (Buru).

Note. Two sterile collections (bb. 22808, 31349 from Buru) differ in their larger leaves drying distinct purplish beneath, with relatively longer petioles (cf. VAN SLOOTEN, l.c. 60: *Shorea* ? *spec. nov.*).

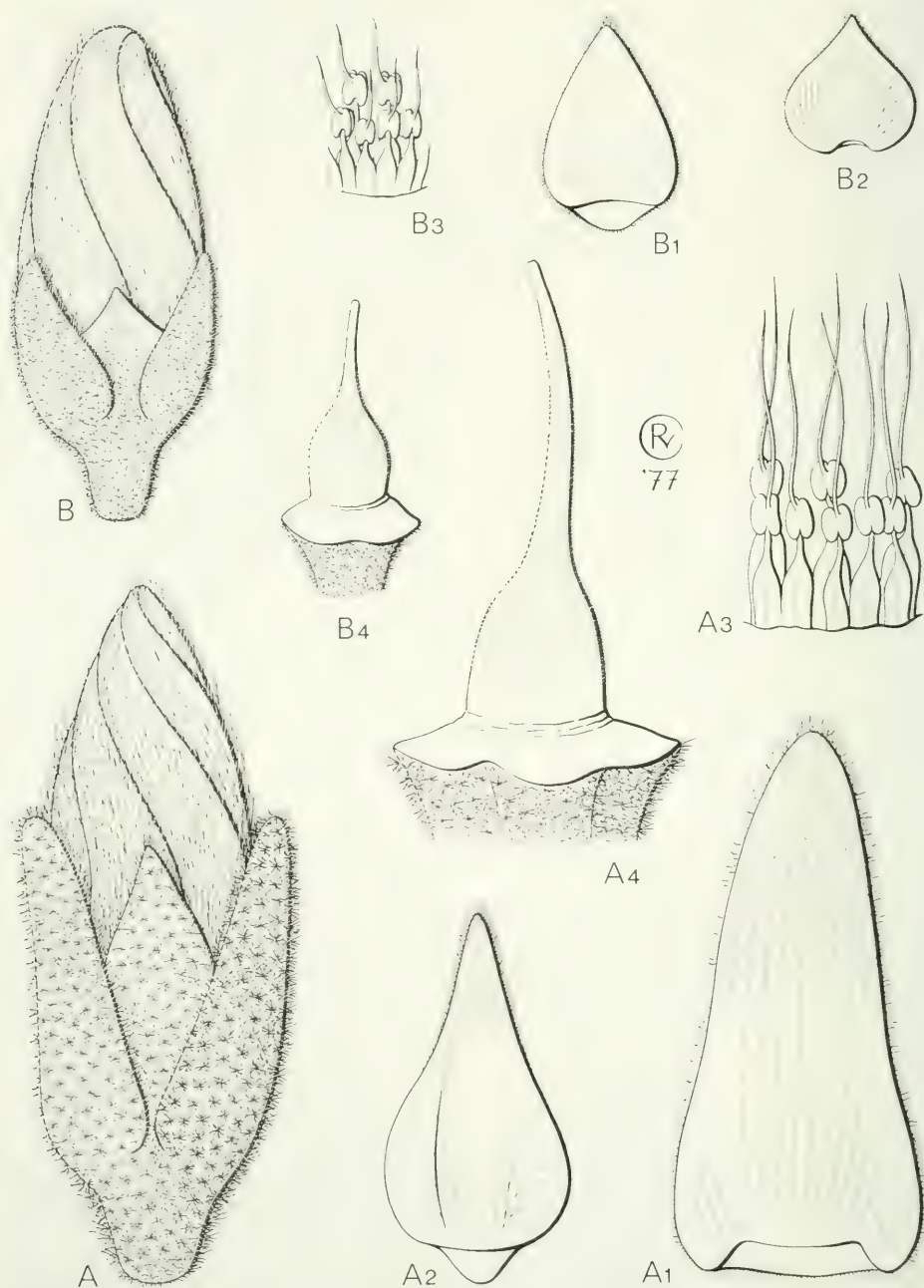


Fig. 99. Flower details in *Shorea* sect. *Brachypterae* HEIM subsect. *Brachypterae*. All  $\times 10$ . Sepals drawn from inside. — *S. scaberrima* BURCK. A. Bud, A1. outer sepal, A2. inner sepal, A3. stamens from outside, A4. pistil. — *S. venulosa* WOOD ex MEIJER. B. Bud, B1. outer sepal, B2. inner sepal, B3. stamens from outside, B4. pistil (A Cult. Hort. Bog. VIII-D-54, B SAIDI 9486).



The only red meranti east of Wallace's line, this striking species enigmatically shares its characteristic leaf shape, as well as its pendent inflorescence, flower structure and very hard durable wood with that equally distinctive denizen of the N.W. Borneo peat swamps *S. inaequilateralis*. If only their evolution could be traced!

**101. *Shorea flemmichii*** SYM. Gard. Bull. S. S. 10 (1939) 378, pl. 26; BROWNE, For. Trees Sarawak & Brunei (1955) 147; ASHTON, Man. Dipt. Brun. (1964) 190, f. 17, pl. 48 (bark); *ibid.* Suppl. (1968) 108.

Large tree with dark deeply fissured flaky bark and stout buttresses. Young twig, panicle, leaf bud, stipule outside (glabrescent within), petiole, midrib beneath and at base above and nervation beneath densely persistently scabrid golden-tawny tufted tomentose; leaf above scabrid puberulent. Twig stout though tapering to 2 mm  $\varnothing$  apically, much branched, terete, verruculose; stipule scars short, horizontal, obscured by the tomentum. Bud 3–6 by 2–4 mm, ovoid, slightly compressed, subacute. Stipule to 8 by 2.5 mm, narrowly hastate, acute, fugaceous. Leaves 5–9 by 3–4.5 cm, broadly elliptic or ovate (young trees), cream lepidote beneath; base obtuse; acumen to 5 mm long, narrow; margin revolute; nerves 14–17 pairs, dense, prominent beneath, at 45°–65°; tertiary nerves scalariform, sinuate, diagonal to nerves; midrib narrow and slightly depressed above, prominent beneath; petiole 7–9 mm long, short. Panicle to 8 cm long, terminal or axillary, terete or slightly compressed; singly or doubly irregularly branched, branchlets to 5 cm long, lax, rather zig-zag, bearing to 8 distichous flowers; bracteoles to 6 by 5 mm, suborbicular, obtuse, shortly puberulent outside, glabrous within. Flower bud to 4.5 by 3.5 mm, subglobose, obtuse. Calyx densely tawny pubescent outside, glabrous within; 3 outer lobes somewhat longer, narrowly ovate, subacute; 2 inner lobes narrowly deltoid, subacute. Corolla dark wine-red, strongly contorted, apically recurved, the imbricate bases forming a deep cup; petals oblong-lanceolate, obtuse, twisted, densely tomentose on parts exposed in bud. Stamens 15, the 5 inner slightly longer than the others; filaments broad at base, tapering abruptly and filiform distally; anthers subglobose; appendage to connective c. 3 times as long as anther, reaching almost to style apex. Ovary and stylopodium ovoid-conical, puberulent towards the apex, tapering; style glabrous, filiform, as long as ovary. Fruit subsessile. Calyx puberulent; 3 longer lobes to 6.5 by 1.5 cm, spatulate, narrowly obtuse, to 2.5 mm broad above the to 7 by 6 mm ovate-elliptic shallowly saccate slightly thickened base; 2 shorter lobes to 20 by 1.5 mm, linear, similar at base. Nut subacute, ovoid, to 1.5 by 1 cm, shortly densely pale buff pubescent.

Distr. *Malesia*: N.W. Borneo (Sarawak & Brunei).

Ecol. Very local, deep yellow sandy soils in Mixed Dipterocarp forest below 400 m, on present or Pleistocene coastal hills.

Vern. *Mēranti raya* (Brun.).

**102. *Shorea almon*** FOXW. Philip. J. Sc. 67 (1938) 313, pl. 7; BROWNE, For. Trees Sarawak & Brunei (1955) 150; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 93, f. 1; ASHTON, Man. Dipt. Brun. Suppl. (1968) 104, f. 13. — *S. furfuracea* (non MIQ.) ROLFE, J. Bot. 23 (1885) 110; VIDAL, Rev. Pl. Vasc. Filip. (1886) 62; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 98; FOXW. Philip. J. Sc. 4 (1909) Bot. 517; WHITFORD, Philip. J. Sc. 4 (1910) Bot. 712; Bull. Bur. For. Philip. 10 (1911) 63. — *S. eximia* (non (MIQ.) SCHEFF.) FOXW. Philip. J. Sc. 6 (1911) Bot. 276; *ibid.* 13 (1918) Bot. 191; MERR. En. Philip. 3 (1923) 96; REYES, Philip. J. Sc. 22 (1923) 331. — **Fig. 7.**

Large buttressed tree. Twig, bud, stipule outside, petiole and leaf nervation beneath densely persistently pink-brown scabrid tomentose; stipule inside and nervation above sparsely, midrib above densely evenly so. Twig c. 2 mm  $\varnothing$  apically, terete, smooth; stipule scars short, horizontal, obscure. Bud to 4 by 3 mm, ovate, compressed, acute. Stipule to 10 by 5 mm, lanceolate, acute, caducous. Leaves 9–16 by 3.5–7 cm, chartaceous, undulate, the lower surface markedly concave; base broadly cuneate to obtuse; acumen to 8 mm long, short, broad; nerves 17–20 pairs, slender but prominent beneath, at 40°–60° (to 100° at the base); tertiary nerves densely scalariform, at 90° to midrib, appanate above, prominent beneath; petiole 10–18 mm long, slender. Panicle 20 cm long, terminal or axillary, terete, slender, ascending, lax, densely shortly unevenly persistently pale pink-brown pubescent; singly branched, branchlets to 2.5 cm long, bearing to 10 distichous flowers; bracteoles to 5 by 3 mm, elliptic, obtuse, yellow-brown puberulent, persistent until the formation of young fruit. Flower bud to 7 by 3 mm, lanceolate, small. Sepals pubescent on parts exposed in bud; 3 outer deltoid, acute, 2 inner ovate, acuminate, smaller. Petals lanceolate, hirsute on parts exposed in bud. Stamens 15, in 3 unequal verticils; filaments compressed at base, abruptly tapering medially and filiform below the subglobose anthers; appendage to connective slender, glabrous, c. 3  $\times$  length of anther. Ovary ovoid, pubescent; style filiform, to 1½  $\times$  length of ovary, pubescent in the basal ½. Fruit pedicel to 3 mm long, prominent. Calyx pale yellow-brown pubescent at base, glabrescent distally; 3 longer lobes to 14 by 2.5 cm, broadly spatulate, obtuse, c. 8 mm broad above the to 13 by 12 mm ovate thickened saccate base; 2 shorter lobes to 8 by 1 cm, lorate, obtuse, similar at base. Nut to 2 by 1.5 cm, ovoid, very shortly mucronate at the otherwise obtuse apex, shortly evenly pale buff pubescent.

Distr. *Malesia*: N.E. Borneo (N.E. Sarawak, rare; E. Sabah, Tidung), Philippines (non-seasonal areas).

Ecol. Undulating hills in Mixed Dipterocarp forest, clay soil.

Vern. *Sēraya kērukup* (Sabah), *almon* (Philippines).

Note. Particularly variable in Mindanao, where the leaves are very small, and the tomentum more sparse and scabrid in some trees.

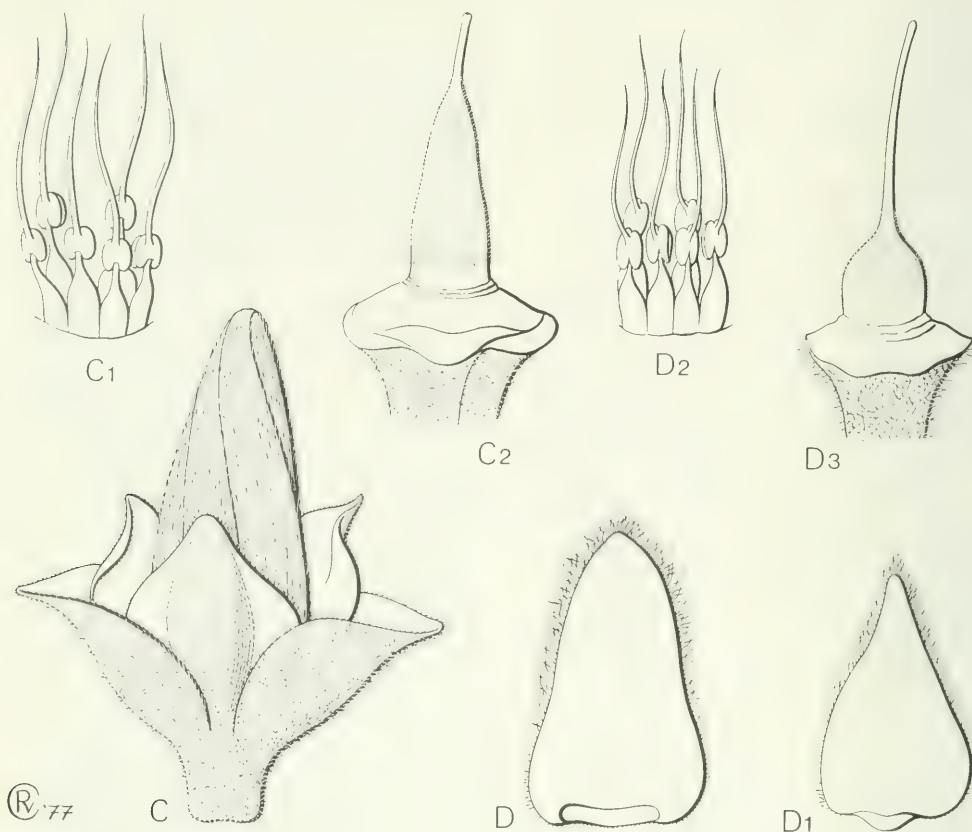


Fig. 100. Flower details in *Shorea* sect. *Brachypterae* HEIM subsect. *Brachypterae*. All  $\times 10$ . Sepals drawn from inside. — *S. flaviflora* WOOD ex ASHTON. C. Bud, C1. stamens from outside, C2. pistil. — *S. johorensis* FOXW. D. Outer sepal, D1. inner sepal, D2. stamens from outside, D3. pistil (C ASHTON 5664, D SAN 31246).

**103. *Shorea parvistipulata*** HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 974; ASHTON, Gard. Bull. Sing. 31 (1978) 46.

#### KEY TO THE SUBSPECIES

1. Leaf not lepidote beneath.
  2. Nerves 13–21 pairs. Longer fruit calyx lobes to 20 cm long . . . . . **a. ssp. *parvistipulata***
  2. Nerves at most 15 pairs. Longer fruit calyx lobes to 9 cm long . . . . . **b. ssp. *nebulosa***
1. Leaf silvery lepidote beneath. Nerves 13–21 pairs . . . . . **c. ssp. *albifolia***

**a. ssp. *parvistipulata*.** — BRANDIS, J. Linn. Soc. Bot. 31 (1895) 95; MERR. En. Born. (1921) 406 ('*parvistipula*'); MEIJER & WOOD, Sabah For. Rec. 5 (1964) 132; ASHTON, Man. Dipt. Brun. Suppl. (1968) 114, f.

14. — *S. squamata* (non BENTH. & HOOK. f.) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 92; MERR. En. Born. (1921) 407, p.p. *quoad sp. Born.* — *S. dyeri* (non THW. ex TRIM.) HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 957. — *S. cristata* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 97; MERR. En. Born. (1921) 404; ASHTON, Man. Dipt. Brun. (1964) 106, f. 17; *ibid.* Suppl. (1968) 106; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 102.

Very large thinly scaly-barked buttressed tree. Leaf bud, stipule outside, twig, petiole and leaf nervation beneath shortly persistently pale yellow to grey-brown scabrid tomentose, stipule inside and midrib above evenly, not scabridly, so. Twig c. 2 mm  $\varnothing$ , terete, slender, becoming smooth; stipule scars short, pale, prominent, horizontal or descending. *Bud* to 6 by 4 mm, ovoid, acute. *Stipule* to 14 by 7 mm, ovate, subacute. *Leaves* 6–20 by 3–9 cm, very variable in size and shape,  $\pm$  oblong, chartaceous; base typically



cordate, sometimes broadly cuneate or obtuse; acumen to 1 cm long; nerves 13–21 pairs, usually slender, at 50°–80° except at the base, without secondary nerves; tertiary nerves slender, densely scalariform; midrib evident but appanate to depressed above, prominent beneath; *petiole* 12–15 mm long, short, terete. *Panicle* to 16 cm long, terminal or axillary, terete, lax, straight, ascending, densely shortly persistently pale pubescent on parts exposed in bud; 3 outer narrowly deltoid, acute, 2 inner ovate, narrowly acuminate, shorter and thinner at margins than outer 3. *Petals* cream suffused with pink at base, lanceolate, pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments broad and compressed at base, tapering abruptly and filiform beneath the anthers; appendage to connective slender, glabrous, about twice length of anthers. *Ovary* ovoid, densely pubescent; style filiform, about as long as ovary, glabrous but for a pubescent ring at base. *Fruit pedicel* to 2 mm long, to 3 mm  $\varnothing$ . *Calyx* puberulent towards base, glabrescent distally; 3 longer lobes to 20 by 2.5 cm, lorate-spatulate, obtuse, c. 11 mm broad above the to 14 by 18 mm broadly ovate saccate thickened base; 2 shorter lobes to 8 by 0.4 cm, linear, similar at base. *Nut* to 2.5 by 2 cm, ovoid, frequently crowned by a persistent filiform style remnant, densely evenly buff pubescent.

Distr. *Malesia*: Borneo (excepting S.W.).

Ecol. Widespread on clay-rich soils on alluvium and especially hillsides and low ridges to 1300 m.

Vern. *Sēraya lupa* (Sabah), *ēngkabang pinang*, *e. p. bērsisek* (Sarawak), *kawang pinang* (Brunei), *tēnggerawan kuming* (Nunukan), *kēnuar kepas* (S.E. Borneo).

Note. I no longer consider that *S. cristata* can be maintained as a separate species. *S. palosapis* (BLCO) MERR. is undoubtedly closely allied but differs in its alexical stipule scars, large, deltoid, subpersistent stipules, and its oblong irregular crown, branching from low on the bole.

**b. ssp. *nebulosa*** (MEIJER) ASHTON, Gard. Bull. Sing. 31 (1978) 46. — *S. nebulosa* MEIJER, Act. Bot. Neerl. 12 (1963) 337; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 123.

*Leaves* at most 13 by 6 cm, with at most 15 pairs of nerves. *Fruit calyx lobes* at most 9 by 1.8 cm.

Distr. *Malesia*: N.E. Borneo (Crocker Range and Mt Kinabalu region).

Ecol. Hill forests between 800–1300 m.

**c. ssp. *albifolia*** ASHTON, Gard. Bull. Sing. 31 (1978) 46. Differing in the silvery pink lamina undersurface.

Distr. *Malesia*: Borneo: N.E. Sarawak (Niah), Brunei and S.E. Sabah southwards to Balikpapan.

Ecol. Fertile soils on undulating land and periodically inundated alluvium.

Note. A collection of this subspecies from E.

Kalimantan with short fruit sepals emphasises the doubtful distinctness of *S. fallax* from this species.

**104. *Shorea balangeran*** (KORTH.) BURCK, Ann. Jard. Bot. Btzig 6 (1887) 214; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 297; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 86; BOERL. Cat. Hort. Bog. 2 (1901) 108, *incl. var. angustifolia* BOERL.; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 297; *ibid.* ed. 2 (1927) 1115; MERR. En. Born. (1921) 404; SLOOT, Bull. Bot. Gard. Btzig III, 18 (1949) 256, f. 12. — *Hopea balangeran* KORTH. Kruidk. (1841) 74, t. 7 f. 1–14; BL. Mus. Bot. Lugd.-Bat. 2 (1852) 34; WALP. Rep. 5 (1845) 128; Ann. 4 (1857) 339; MIQ. Fl. Ind. Bat. 1, 2 (1859) 503; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 84, 85; DC. Prod. 16, 2 (1868) 634; HEYNE, Nutt. Pl. ed. 2 (1927) 1115. — *Parahopea balangeran* HEIM, Rech. Dipt. (1892) 66. — *Parashorea balangeran* MERR. En. Born. (1921) 404 — **Fig. 91 D–D4.**

Large buttressed tree. Twig, leaf bud, stipule, petiole, midrib and nerves beneath, panicle and calyx outside shortly densely persistently red-brown puberulent; leaves beneath cream lepidote; nut apex sparsely puberulent. *Twigs* c. 2 mm  $\varnothing$  apically, slender, terete, smooth. *Buds* 5 by 3 mm, ovoid, acute; *stipule* to 7 by 4 mm, ovate, acute. *Leaves* 7–18 by 3–8 cm, oblong-elliptic to lanceolate, coriaceous, conspicuously cream beneath; base broadly cuneate to obtuse; acumen to 1.5 cm long, slender, tapering; nerves 13–18 pairs, slender, barely elevated beneath, evident above, at 45°–55°; tertiary nerves densely scalariform, obscure; midrib slender but prominent beneath, obscurely depressed above; *petioles* 2–3 cm long, slender. *Panicle* to 8 cm long, slender, terminal or axillary; doubly branched, branchlets to 3 cm long, with to 7 second flowers. *Flower buds* to 6 by 3 mm, fusiform; 3 outer *sepals* narrowly lanceolate, subacute; 2 inner short, ovoid, prominently acuminate. *Stamens* 15, shorter than style at anthesis; filaments compressed at base, gradually tapering and filiform below the broadly ovoid anthers; appendages very slender, glabrous, twice length of anthers; *ovary* ovoid, puberulent; style columnar, c.  $1\frac{1}{2} \times$  length of ovary, puberulent towards base, not trifid. *Fruit pedicel* short, slender. 3 longer *calyx lobes* to 50 by 7 mm, spatulate, obtuse, c. 2 mm broad above the to 4 by 3 mm ovate saccate thickened base; 2 shorter lobes to 15 by 2 mm, linear, similar at base. *Nut* to 6 by 4 mm, ovoid, apiculate.

Distr. *Malesia*: Borneo (throughout Indonesian part), Sumatra (Banka, Billiton).

Ecol. Common, often gregarious, in peat swamp forests.

Vern. *Balangeran*, *kawi*, *kahoi*, *tomi*, *kelansauw* (Borneo), *malangsir* (Banka).

Uses. A major timber produced in the swamps of Indonesian Borneo.

Note. In many ways resembling *S. albida* (q.v.).

**105. *Shorea coriacea*** BURCK, Ann. Jard. Bot. Btzig 6 (1887) 214; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 100;

MERR. En. Born. (1921) 404; BROWNE, For. Trees Sarawak & Brunei (1955) 146; ASHTON, Man. Dipt. Brun. (1964) 182, f. 17; *ibid.* Suppl. (1968) 106; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 102.

Large buttressed tree with dark brown, fissured, flaky bark. Young parts densely clothed in minute adpressed pale grey hairs, caducous on all but panicle, stipule outside and bud. *Twig* 2–3 mm  $\varnothing$  at apex, stout, terete or slightly compressed, smooth or rugulose; stipule scars at first *c.* 1 mm wide, *c.* 1.5 mm long, cuneate, pale brown, horizontal or slightly descending. *Bud* to 6 by 3 mm, ovoid. *Stipule* to 20 by 5 mm, narrowly oblong, acute. *Leaves* 10–15 by 5–8 cm, ovate, coriaceous, lustrous; base obtuse, subpeltate; acumen *c.* 1 cm long; margin revolute; nerves 16–20 pairs, slender, hardly raised beneath, at 60°–70°, curved towards margin; tertiary nerves slender, densely scalariform; midrib prominent beneath, obscure and slightly depressed above; *petiole* 2.5–4 cm long, geniculate, glabrous. *Panicle* to 14 cm long, terminal or axillary,  $\pm$  terete; singly (doubly if terminal) branched, branchlets regular, short, bearing to 10 second flowers; *bracteoles* to 4 by 2.5 mm, ovate, subacute, sparsely pubescent outside, glabrescent within. *Flower bud* to 6 by 1.2 mm, narrowly lanceolate, acute. *Calyx* densely pale grey pubescent outside, glabrous within; 3 outer lobes narrowly deltoid, subacute, slightly revolute; 2 inner lobes smaller, acute, not revolute. *Petals* pink, linear, densely pubescent on parts exposed in bud. *Stamens* 15, of 2 lengths, the inner 5 an anther's length longer; anther subglobose; appendage to connective 2–3 times as long as anther, slender, not reflexed, reaching almost to style apex. *Ovary* ovoid, densely shortly pubescent except at the base; style filiform, as long as ovary, glabrous but for the setose base; stylopodium indistinct. *Fruit calyx* shortly sparsely pubescent or glabrescent except towards base; 3 longer lobes to 9 by 1.5 cm, spatulate; chartaceous, narrowly obtuse, 3–4 mm broad above the *c.* 8 by 5 mm deltoid thickened saccate base; 2 shorter lobes to 3.5 cm long, subequal, linear, similar at base. *Nut* *c.* 18 by 9 mm, ovoid, shortly grey pubescent distally; style remnant *c.* 3 mm long, slender, acute.

Distr. *Malesia*: Borneo (Lower Kapuas, Sarawak, Brunei, S.W. Sabah, Sandakan Distr., W. Kutei, and Muara Teweh).

Ecol. Heath forest on podsols, terraces and plateaux to 1000 m; on ultrabasics in E. Borneo.

Vern. *Samar benua*, *mēranti jurai* (W. Borneo), *lampong mēngkabang* (S.E. Borneo), *mēranti tangkai panjang* (Sarawak), *sēraya t.p.* (Sabah).

**106. *Shorea venulosa*** WOOD *ex* MEIJER, Act. Bot. Neerl. 12 (1963) 342, p. 10; Sabah For. Rec. 5 (1964) 153; ASHTON, Man. Dipt. Brun. (1964) 226, f. 17; *ibid.* Suppl. (1968) 122. — **Fig. 99 B–B4.**

Large buttressed tree with dark brown, fissured, flaky bark. Young parts at first densely dotted with minute adpressed hair tufts, fugaceous on all but stipule outside and leaf bud; stipule persistently

shortly pubescent within. *Twig* *c.* 1 mm  $\varnothing$  apically, slender, much branched, terete, rugulose or smooth, glabrous; stipule scars narrow, slightly paler at first, almost or completely amplexicaul,  $\pm$  ascending. *Bud* to 7 by 2 mm, fulvous pale grey, lanceolate, compressed, acute. *Stipule* to 20 by 3.5 mm, hastate, acute, fugaceous. *Leaves* 6–10 by 3–5 cm (rarely much smaller in exposed places), ovate, coriaceous; base obtuse; acumen to 6 mm long; margin sometimes slightly revolute; nerves 15–18 pairs, slender, hardly or not elevated beneath, dense, at 35°–40°, curved towards the margin, sometimes with prominent axillary pore-like domatia; tertiary nerves very slender, densely scalariform, diagonal to nerves; midrib raised beneath, obscure and depressed above; *petiole* 1.7–3 cm long, slender, geniculate. *Panicle* to 11 cm long, terminal or axillary, slender, lax,  $\pm$  terete, shortly densely persistently cream to pale grey pubescent; singly or doubly branched, the branchlets short, bearing to 10 second flowers; *bracteoles* to 3.5 by 2 mm, ovate, obtuse, sparsely pubescent outside, glabrous within. *Bud* to 5 by 2.5 mm, narrowly ovoid, subacute. *Calyx* densely pale grey pubescent outside, glabrous within; 3 outer lobes narrowly deltoid, subacute, slightly revolute; 2 inner lobes smaller, acute, not revolute. *Petals* pink, oblong-lanceolate, pubescent on parts exposed in bud. *Stamens* 15, the inner 5 slightly longer than the others; filaments broad at base, rather abruptly tapering and filiform distally; anther oblong; appendage to connective over twice as long as anther, reaching almost to style apex. *Ovary* narrowly ovoid, shortly pubescent, longer pubescent towards apex; stylopodium indistinct; style filiform, somewhat shorter than ovary, glabrous but for shortly pubescent base. *Fruit calyx* sparsely puberulent, more densely so at base; 3 longer lobes to 6 by 1.3 cm, chartaceous, spatulate, narrowly obtuse, *c.* 3.5 mm broad above the *c.* 7 by 5 mm deltoid saccate thickened base; shorter lobes to 3 by 0.3 cm, subequal, linear, similar at base. *Nut* *c.* 20 by 8 mm, narrowly ovoid, shortly pubescent towards the apex, otherwise glabrous; style remnant acute.

Distr. *Malesia*: Northern Borneo (Sarawak, Brunei, Sabah).

Ecol. On podsols in Heath forest, on terraces, plateaux and ridges to 1600 m; locally common; on ultrabasics in E. Sabah.

Vern. *Mēranti tangkai panjang padi* (Brunei), *sēraya kērangas* (Sabah).

Note. Closely resembling *S. coriacea*, within whose range it is confined, and occupying similar habitats. No record yet exists though of intermediate forms.

**107. *Shorea waltoni*** WOOD *ex* MEIJER, Act. Bot. Neerl. 12 (1963) 344, pl. 11; Sabah For. Rec. 5 (1964) 155.

Tall buttressed tree with deeply fissured bark. Twigs, leaf buds, stipules, petioles, nervation beneath and panicle  $\pm$  densely cream lepidote; calyx at first densely so, becoming sparse,  $\pm$  caducous in fruit; midrib above and sometimes nerves, ovary and parts of petals exposed in bud densely persistently cream-



brown pubescent. *Twigs* c. 3 mm  $\varnothing$  apically, stout, terete, becoming smooth, dark brown; stipule scars  $\pm$  amplexicaul, slender. *Buds* small, conical; *stipules* to 20 by 8 mm, elliptic-lanceolate, acute. *Leaves* 10–25 by 5.5–12 cm, oblong to ovate or obovate, coriaceous, cream lepidote beneath; base obtuse or shallowly cordate; apex abruptly to 1 cm long acuminate; nerves 18–22 pairs, slender but prominent beneath, drying dark,  $\pm$  applanate above; tertiary nerves scalariform, elevated beneath; midrib prominent beneath, obscure and depressed above, *petiole* 2.5–4.5 cm long, stout. *Panicle* to 12 cm long, rather stout, terminal or axillary; singly or doubly branched, branchlets to 5 cm long; *bracts* to 10 mm long, amplexicaul. *Flower bud* to 8 by 3 mm, fusiform; *sepals* ovate, the outer 3 longer, acute, the inner 2 broader, acuminate. *Stamens* 15, unequal; filaments broadly compressed at base, abruptly tapering and filiform distally; anthers broadly oblong; appendages slender, scarious apically, c.  $2 \times$  length of anthers. *Ovary* broadly ovoid; style equal in length to ovary, rather short, puberulent in the basal  $\frac{1}{2}$ . *Fruit pedicel* c. 3 mm long, stout; 3 longer *calyx lobes* to 14 by 2.3 cm, spatulate, obtuse, coriaceous, c. 11 mm wide above the c. 8 by 15 mm transversely elliptic saccate thickened base; 2 shorter lobes to 10 by 0.8 cm, lorate, spatulate, narrowly obtuse. *Nut* to 25 by 18 mm, ovoid, apiculate.

Distr. *Malasia*: N. E. Borneo (Sandakan Distr.).

Ecol. Scattered on well or moderately drained land in lowlands.

Vern. *Sēraya kēlabu*.

**108. *Shorea pachyphylla* RIDL.** [DURANT, Rep. For. Brunei (1933) 41, *nomen*] ex SYM. J. Mal. Br. R. As. Soc. 19 (1941) 163, pl. 7; BROWNE, For. Trees Sarawak & Brunei (1955) 148; ANDERSON, Gard. Bull. Sing. 20 (1963) 19; ASHTON, Man. Dipt. Brun. (1964) 205, f. 17, pl. 54 (habit, bark); *ibid.* Suppl. (1968) 112. — **Fig. 101.**

Large buttressed tree with pale flaky and prominently fissured bark. Young parts very shortly densely evenly tawny pubescent, caducous on all but leaf bud, panicle and stipule (puberulent on inner surface). *Twig* c. 4 mm  $\varnothing$ , stout, terete, slightly ridged and compressed apically, becoming smooth or rugulose; stipule scars c. 0.5 mm broad, horizontal, normally amplexicaul. *Bud* 5–8 by 2–4 mm, compressed or terete, narrowly ovoid to broadly falcate. *Stipule* to 20 by 7 mm, lanceolate, acute, fugaceous. *Leaves* 10–20 by 9–16 cm, broadly ovate to suborbicular, thickly coriaceous; base obtuse or broadly cuneate; apex obtuse or with short, to 5 mm long, acumen; margin slightly but distinctly revolute; nerves 7–9 pairs, well spaced, prominent beneath, arched at margin, at c.  $40^{\circ}$ – $55^{\circ}$ ; midrib applanate and broad above, terete and prominent beneath; tertiary nerves slender, densely scalariform, at  $90^{\circ}$  to midrib; *petiole* 4–6 cm long, stout. *Panicle* to 11 cm long, terminal or axillary, compressed, ridged when dry; doubly branched, the branchlets bearing to 5 distichous flowers; *bracteoles* to 3 by 2 mm, ovate, acute, shortly pubescent. *Flower*

*bud* to 6 by 4 mm, narrowly ovoid, acute. *Calyx* densely pubescent outside; lobes ovate, deltoid, acuminate, the 3 outer somewhat longer, more obtuse, than the 2 inner lobes. *Petals* broadly lanceolate, obtuse, hardly contorted, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 lengths, the inner 5 an anther's length longer than the outer 5; filaments broad at base, tapering and stoutly filiform distally; anthers subglobose; appendage to connective  $3-4 \times$  length of anther, pubescent towards apex, otherwise glabrous; *stylopodium* indistinct, sparsely pubescent, tapering into style; style and stylopodium longer than ovary. *Fruit calyx* entirely glabrous; 3 longer lobes to 16 by 3.5 cm, spatulate, obtuse, c. 7 mm broad above the to 2 by 1.5 cm thickened saccate base; 2 shorter lobes to 8 by 0.6 cm, narrowly spatulate, similarly saccate at base. *Nut* to 3.3 by 1.8 cm, ovoid, pruinose, buff pubescent towards the apex; style remnant c. 1.5 mm long, acute.

Distr. *Malasia*: N.W. Borneo (Sarawak, Brunei and Kalimantan: Lower Kapuas and Barito).

Ecol. Locally gregarious, mixed peat swamp forests, especially on and beside white sand raised beaches.

Vern. *Kukup, kērukup, mēranti kērukup* (Brunei).

**109. *Shorea pauciflora* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 116; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 98; BURK. J. Str. Br. R. As. Soc. 81 (1920) 51, 69, fig.; RIDL. Fl. Mal. Pen. 1 (1922) 228; FOXW. Mal. For. Rec. 3 (1927) 51, *p.p.*; *ibid.* 10 (1932) 218; SLOOT. in Merr. Pl. Elm. Born. (1929) 203; BURK. Dict. (1935) 2020; SYM. Mal. For. Rec. 16 (1943) 87, f. 37A, 38, 52; BROWNE, For. Trees Sarawak & Brunei (1955) 149; ASHTON, Man. Dipt. Brun. (1964) 207, f. 17, pl. 46 (bark); *ibid.* Suppl. (1968) 114; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 133, f. 15; ASHTON, Gard. Bull. Sing. 31 (1978) 47.**

Large buttressed tree. Leaf bud, stipule and panicle persistently shortly pale gold-brown pubescent; nervation, petiole and young twig sparsely dotted with minute caducous hair tufts. *Twig* 1.5–2.5 mm  $\varnothing$ , terete at first smooth, becoming flaky; stipule scars pale, short, narrow, horizontal. *Bud* 4–8 by 2–3.5 mm, ovoid, acute. *Stipule* to 13 by 4 mm, hastate, acute. *Leaves* 9–15 by 4–5.5 cm, ovate,  $\pm$  thinly coriaceous, frequently subequal; base obtuse to broadly cuneate; acumen 0.6–1.2 cm long, narrow; nerves 8–9 pairs, slender but prominent beneath, at c.  $40^{\circ}$ – $50^{\circ}$ , straight, slightly curved at the margin, occasionally with a few glabrous domatia; tertiary nerves very slender, densely scalariform, diagonal to the nerves; midrib narrowly depressed above, prominent beneath; petiole 1.3–1.8 cm long. *Panicle* to 15 cm long, terminal or axillary, ribbed or slightly compressed, lax; doubly or trebly branched, the branchlets bearing to 19 second flowers; bracteoles to 4 by 2.5 mm, oblong, subacute, shortly densely pale yellow-brown to pubescent fugaceous. *Flower bud* c. 7 by 3.5 mm, ovoid, subacute. *Calyx* densely pale yellowish buff pubescent outside, glabrous within; lobes subequal, deltoid, obtuse, the 2



Fig. 101. *Shorea pachyphylla* RIDL. ex SYM. a. Habit, b. twig apex with leaf, c. fruit, d. nut, all  $\times \frac{1}{2}$  (a bb. 31414, b-d S 11245).



inner slightly narrower. *Petals* pale yellow, oblong, obtuse, densely pubescent on parts exposed in bud. *Stamens* 15, the inner 5 slightly longer than the other 10; filaments expanded at base, abruptly narrowing distally; anthers broadly oblong; appendage to connective c.  $2 \times$  length of anther. setose towards the apex, the inner 5 reaching the style apex. *Ovary* and *stylopodium* ovoid to conical, shortly densely pubescent; style glabrous, slightly shorter than ovary and stylopodium. *Fruit* subsessile. *Calyx* sparsely pubescent, more densely so at base; 3 longer lobes to 9 by 1.5 cm, spatulate, narrowly obtuse, c. 4 mm broad above the c. 8 by 11 mm rounded thickened saccate base; 2 shorter lobes to 5 by 0.5 cm, linear, similar at base. *Nut* c. 1.4 by 1.2 cm, broadly ovoid, obtuse or with a short acute style remnant, densely pale buff tomentose.

Distr. *Malesia*: Malaya, Sumatra (extreme north and the south excepted, incl. P. Siberut), Borneo.

Ecol. Scattered, rarely common, on deep soils on undulating land and hills below 700 m.

Uses. A valuable heavy red meranti.

Vern. *Nĕmesu, lamsa, lemesa, lemesa samak, mĕsu, mĕranti benia, m. samak, kala samak, mĕndamak, pinang baik, sĕraya, s. batu, tĕmpayan mas* (Malaya). *katuko, k. andilan, k. tikau, mĕranti udang* (Sumatra). *ubar suluk* (Sabah), *mĕranti samak, ĕngkabang cheriak* (Sar.), *pĕrawan samak* (Iban), *lampong merantas, l. tahan, pelĕpak, kĕlapak, k. undang, putang lanan, awang kulat, a. laying, mĕrkabong* (S.E. Borneo). *tĕngkawang tijang, t. rambai, kontoi, k. lemak* (W. Borneo), etc.

Note. Variable in leaf size and colour: small-leaved forms tend to have leaves drying rust-red, large-leaved chocolate-brown with the nerves and petiole distinctly paler.

**110. *Shorea johorensis*** Foxw. Mal. For. Rec. 10 (1932) 236, pl. 21; BURK. Dict. (1935) 2012; SYM. Mal. For. Rec. 16 (1943) 72, f. 38; ASHTON. Gard. Bull. Sing. 22 (1967) 294. — *S. polysperma* (non MERR.) KEITH. North Born. For. Rec. 2 (1938) 238. — *S. leptoclados* SYM. Gard. Bull. S. S. 10 (1939) 376, pl. 25; Mal. For. Rec. 16 (1943) 77; BROWNE. For. Trees Sarawak & Brunei (1955) 140; ASHTON, Man. Dipt. Brun. (1964) 195, f. 17; *ibid.* Suppl. (1968) 110; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 112, f. 13, pl. 6 (habit). — **Fig. 100 D-D3.**

Large buttressed tree. Twig, panicle, leaf bud, stipule, petiole, nervation beneath and midrib above shortly evenly persistently grey-buff pubescent; young leaf caducously so. *Twig* 2–3 mm  $\varnothing$  apically, much branched, slightly ribbed and compressed when young, becoming terete, drying glabrous, smooth; stipule scars 1.5–2 mm long, pale, falcate, descending. *Bud* 6–8 by 2–3 mm, ovoid, compressed. *Stipule* to 3.5 by 0.7 mm,  $\pm$  caducous, lanceolate, acute, constricted at base. *Leaves* 9–14 by 4.2–7.5 cm, chartaceous to thinly coriaceous, ovate; base obtuse to subcordate; acumen to 7 mm long; nerves 10–12 slender but prominent pairs, at  $90^\circ$  at base, c.  $40^\circ$ – $50^\circ$  towards apex; first 3–6 pairs usually with prominent scale-like

domatia, the basal two pairs of which fused along the midrib on each side; tertiary nerves very slender, densely scalariform, sinuate, diagonal to nerves; *petiole* slender, 1.5–2 cm long. *Panicle* to 15 cm long, terminal or axillary, terete or slightly compressed, slender; regularly singly or doubly branched, branchlets long, lax, bearing to 18 second flowers; *bracts* to 7 mm long, narrowly ovate, obtuse, pubescent on both surfaces, fugaceous. *Flower bud* to 8 by 3.5 mm, ovoid to lanceolate, acute. *Calyx* densely pale grey pubescent outside, glabrous within; lobes subequal, acute, slightly revolute towards the apices. *Petals* pale yellow, narrowly lanceolate, obtuse, densely pubescent on parts exposed in bud. *Stamens* 15, the 5 innermost only slightly longest; filaments expanded at base, abruptly narrowing and filiform distally; anthers oblong, somewhat tapering; appendage to connective c.  $3 \times$  length of anther, reaching  $\frac{2}{3}$  length of style, glabrous. *Ovary* globose, shortly densely pubescent in apical half, stylopodium indistinct; style over twice as long as ovary, filiform, glabrous but for base. *Fruit* calyx shortly pubescent towards base, glabrescent; 3 longer lobes to 12 by 2.3 cm, subequal, spatulate, narrowly obtuse, c. 6 mm broad above the to 1.4 by 1.2 cm deltoid saccate thickened base; 2 shorter lobes to 6.5 by 0.6 cm, unequal, linear but similar at base. *Nut* to 2 by 1.4 cm, broadly ovoid, densely shortly pale buff tomentose; style remnant short.

Distr. *Malesia*: Malaya (E. Johore), Sumatra (East coast: Simelungun, Djambi, Palembang), Borneo (Sarawak, Sabah, S.E. Borneo to Muara Tewe and Pleihari).

Ecol. Common in Palembang and E. Borneo, local or rare elsewhere, on fertile soils on hillsides, well-drained alluvium and undulating land below 600 m alt.

Vern. *Mĕranti pepijat* (Mal.), *mĕrukuyong* (Sum.), *kĕnuar, kĕnbĕwar, langko, pĕlĕpak* (S.E. Borneo), *majau* (Sabah), *sĕlangan pĕlandok* (Brunei), *mĕrampu* (Iban).

Note. Collections from West Sarawak and the Malay Peninsula lack the basal domatia that so facilitate distinction of sterile material from *S. palembanica*.

**111. *Shorea palembanica*** MIQ. Sum. (1861) 487; DC. Prod. 16, 2 (1868) 632; WALP. Ann. 7 (1868) 379; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 219; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 103; SYM. Gard. Bull. S. S. 7 (1933) 141, pl. 41; Mal. For. Rec. 16 (1943) 83, f. 38; BROWNE, For. Trees Sarawak & Brunei (1955) 141; ASHTON, Man. Dipt. Brun. Suppl. (1968) 112, f. 13. — *S. aptera* BURCK, Ann. Jard. Bot. Btzg 6 (1887) 210, t. 22; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 264; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 78; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 296; MERR. En. Born. (1921) 403; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 260. — *S. brachyptera* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 571; MERR. En. Born. (1921) 404. — *Pachychlamys beccarianus, P. brachypterus* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 77.

*nomina pro syn.* — *S. lepidota* (non BL.) FOXW. Mal. For. Rec. 10 (1932) 166, p.p.

Small or medium-sized, rarely large tree. Young twig, leaf bud, and stipule outside densely evenly pale buff pubescent, stipule inside, petiole and leaf nervation sparsely so, sometimes glabrescent. *Twig* c. 2 mm  $\varnothing$ , compressed apically, becoming smooth, terete; stipule scar short, horizontal. *Bud* to 13 by 6 mm, lanceolate, falcate, acute. *Stipule* to 15 by 3 mm, lanceolate, acute, caducous. *Leaves* 8–25 by 4–10 cm, ovate to oblong, chartaceous, undulating; base broadly cuneate to subcordate; acumen to 1 cm long, broad; nerves 12–16 pairs, slender but prominent beneath, at 45°–65°; tertiary nerves slender, dense; midrib appanate to depressed above, prominent beneath; *petiole* 14–25 mm long, drying ribbed. *Panicle* to 16 cm long, terminal or axillary, terete, shortly evenly persistently pale buff pubescent; doubly branched, branchlets to 5 cm long, bearing to 10 second flowers; *bracteoles* to 4 by 2 mm, ovate, acute, puberulent, caducous. *Flower bud* to 7 by 3 mm, fusiform. *Sepals* ovate, densely pubescent on parts exposed in bud; 3 outer acute, 2 inner smaller, thinner towards the fimbriate margins, acuminate. *Petals* pale yellow, lanceolate, pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed at base, tapering medially and filiform below the broadly ellipsoid anthers; appendage to connective slender, c. 2  $\times$  length of anthers. *Ovary* ovoid, tapering, pubescent; style filiform, c. 2  $\times$  length of ovary, pubescent in the basal  $\frac{1}{4}$ . *Fruit pedicel* to 2 mm long. *Calyx* puberulent, glabrescent, short, 3 longer lobes to 5 by 0.7 cm, lorate, obtuse, with to 2.5 by 2.5 cm ovate thickened prominently saccate base; 2 shorter lobes to 3 cm long, otherwise similar. *Nut* to 3.5 by 2.5 cm, ovoid, apiculate, densely evenly shortly persistently pale yellow-brown pubescent.

*Distr. Malesia:* Malaya (Perak and E. coast), Sumatra (Palembang), Borneo (excluding Sabah, Brunei and Sarawak west of the Lupar).

*Ecol.* River banks, fresh water swamps and rarely low moist hillsides, locally abundant.

*Vern. Mĕranti tĕngkawang ayĕr, singkawang, tĕngkawang, mĕrpak* (Malaya), *mĕrkuyung, mĕlĕbĕkan* (Sumatra), *ĕngkabang asu* (Sarawak), *kĕlĕpak, majau, tĕnkawang, t. rambut, t. ringgit, mĕngkabang* (W. Borneo).

**112. *Shorea andulensis*** ASHTON, Gard. Bull. Sing. 19 (1962) 275, pl. 11; Man. Dipt. Brun. (1964) 178, f. 17; *ibid.* Suppl. (1968) 105; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 97.

Medium-sized to large tree. Twig, panicle, leaf bud, midrib above. Stipule (both surfaces) and petiole shortly densely persistently yellowish buff puberulent, more sparsely so on nervation beneath and midrib above. *Twig* 1.5–2 mm  $\varnothing$  apically, slender, compressed when young, becoming terete, smooth, glabrous; stipule scars short, inconspicuous. *Bud* 3–6 by 1.5–3 mm, ovoid, compressed, subacute. *Stipule* to 14 by 5 mm, hastate, subacute. *Leaves* 6–9 by 3–5 cm,

elliptic-ovate, lepidote beneath in mature tree; base obtuse; acumen to 8 mm long; nerves 10–13 pairs, straight, abruptly curved near margin, slender but prominent beneath, at 40°–50° except at base; tertiary nerves slender, scalariform, sinuate, diagonal to nerves; *petiole* 1–1.2 cm long, 1–1.5 mm  $\varnothing$ , shortly cream puberulent and rugose on drying. *Panicle* to 12 cm long, terminal or axillary, terete or slightly compressed; singly or doubly branched, the branchlets bearing to 10 distichous flowers; *bracts* and *bracteoles* to 3 by 1.2 mm, ovate, subacute, shortly grey puberulent outside, glabrescent within. *Flower bud* to 8 by 2.5 mm, narrowly ovoid, subacute, the calyx spreading. *Calyx* densely shortly pubescent outside, puberulent within; lobes subequal, ovate, acute to subacuminate, the inner 2 more attenuate than the outer 3. *Petals* bright lilac within, paler outside, narrowly lanceolate, acute, twisted, shortly pubescent on parts exposed in bud, saccate at base. *Stamens* 15, the inner 5 only slightly longer than the others; filaments basally expanded, abruptly tapering; anther broadly oblong; appendage to connective c. 3  $\times$  length of anther, straight, unreflexed, reaching almost to the style apex on the 5 inner stamens. *Ovary* small, globose, glabrous; stylopodium indistinct; style c. 2  $\times$  length of ovary, filiform, sparsely pubescent in the basal half. *Fruit calyx* shortly pubescent, more densely so at base; 3 longer lobes to 5 by 1.2 cm, broadly spatulate, narrowly obtuse, c. 2.5 mm broad above the c. 6 by 4 mm narrowly ovate thickened saccate base; 2 shorter lobes to 2.5 by 0.2 cm, linear, subequal, similar at base. *Nut* to 14 by 7 mm, ovoid, abruptly shortly apiculate, shortly densely grey-buff pubescent.

*Distr. Malesia:* Northern Borneo (Ulu Kapuas, Sarawak, Brunei, E. Sabah).

*Ecol.* Rare, on sandy soils in Mixed Dipterocarp forest; on ultrabasics in E. Sabah.

*Vern. Mĕranti daun puteh* (Brun.).

**113. *Shorea polysperma*** (BLCO) MERR. Publ. Govt. Lab. Philip. 27 (1905) 22; *ibid.* 29 (1905) 29; Philip. J. Sc. 1 (1906) Suppl. 98; EVERETT & WHITFORD, Bull. Bur. For. Philip. 5 (1906) 26; FOXW. Philip. J. Sc. 2 (1907) Bot. 356, 357, 394; MERRITT, Bull. Bur. For. Philip. 8 (1908) 16, 48; FOXW. Philip. J. Sc. 4 (1909) Bot. 423, 510, 518; WHITFORD, *ibid.* 4 (1910) Bot. 703; Bull. Bur. For. Philip. 10 (1911) 66; FOXW. Philip. J. Sc. 6 (1911) Bot. 277; *ibid.* 13 (1918) Bot. 191; MERR. Sp. Blanc. (1918) 269; En. Philip. 3 (1923) 99; REYES, Philip. J. Sc. 22 (1923) 328; FOXW. *ibid.* 67 (1938) 309. — *Mocanera polysperma* BLCO, Fl. Filip. 1 (1837) 448. — *Dipterocarpus polyspermus* BLCO, Fl. Filip. ed. 2 (1845) 312; *ibid.* ed. 3, 2 (1878) 213; DC. Prod. 16, 2 (1868) 614; DYER, J. Bot. 12 (1874) 108. — *Hopea tangili* BL. Mus. Bot. Lugd.-Bat. 2 (1852) 35, *nom. illeg.*; WALP. Ann. 4 (1857) 339; DC. Prod. 16, 2 (1868) 635. — *S. talura* (non ROXB.) F.-VILL. Nov. App. (1880) 21. — *S. warburgii* GILG, Bot. Jahrb. 18, Beibl. 45 (1894) 38; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 98; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895)



264; Foxw. Philip. J. Sc. 6 (1911) Bot. 278; *ibid.* 13 (1918) Bot. 191; GILG in E. & P. Pl. Fam. ed. 2, 21 (1925) 260. — *S. teysmanniana* (non DYER) Foxw. Philip. J. Sc. 6 (1911) Bot. 278; *ibid.* 13 (1918) Bot. 192; WHITFORD, Bull. Bur. For. Philip. 10 (1911) 68; MERR. En. Philip. 3 (1923) 99; REYES, Philip. J. Sc. 22 (1923) 326. — **Fig. 7.**

Large buttressed tree. Twigs, buds, stipules, panicles, bracts and parts of petals exposed in bud  $\pm$  densely persistently cream puberulent, petioles, nervation beneath, calyx and ovary so at first becoming glabrous on all but ovary. *Twig* c. 2–3 mm  $\varnothing$  apically, compressed at first, becoming terete, smooth, blackish; stipule scars short, horizontal. *Buds* c. 2 by 1 mm, small, ellipsoid, stipules to 15 by 8 mm, lanceolate, acute, caducous. *Leaves* 7.5–15 by 2.5–6.5 cm, elliptic, thinly coriaceous, occasionally cream lepidote beneath; base cuneate; acumen to 2 cm long, tapering; nerves 9–12 pairs, slender but prominent beneath, slightly elevated above, arched, at  $55^{\circ}$ – $75^{\circ}$ , frequently with glabrous pore-like axillary domatia; tertiary nerves densely scalariform, sinuate, very slender, barely elevated beneath, obscure above; midrib slender but prominent beneath, obscurely depressed above; petiole 16–22 mm long, slender geniculate. *Panicle* to 16 cm long, terminal or axillary, doubly branching, spreading, many-flowered; branchlets to 7 cm long; *bracts* to 5 by 3 mm, ovate-deltoid, acute. *Buds* to 4 by 2 mm, small, fusiform; sepals broadly ovate, the outer 3 acute, the inner 3 smaller, shortly acuminate; *stamens* 15, shorter than style at anthesis; filaments broadly compressed at base, tapering abruptly medially and filiform beneath the subglobose anthers; appendage slender,  $\pm$  glabrous, c.  $2\frac{1}{2} \times$  length of anthers; *ovary* subglobose, abruptly crowned by a slender glabrous style c.  $2 \times$  its length. *Fruit pedicel* to 3 mm long, stout, broadening into the receptacle; 3 longer *calyx lobes* to 9 by 1.8 cm, spatulate, obtuse, coriaceous, c. 6 mm broad above the c. 10 by 10 mm broadly ovate saccate thickened base; 2 shorter lobes to 5 by 0.4 cm, lorate, obtuse, similar at base; *nut* to 18 by 14 mm, ovoid, apiculate.

Distr. *Malesia*: Philippines.

Ecol. Widespread and often common, evergreen Mixed Dipterocarp forest on hills.

Vern. *Tangile* (Tag.), *abuhungan* (Al.), *adamini* (Bis.), *araka* (Ilk.), *balakbakan* (Neg.), *belagayan* (Mangyan), *damilang* (Ibn.), *maligmal* (Tang.), *manaog* (C. Bis.), *mayapis* (Tayabas), *pata* (Pang.).

**114. *Shorea platyclados*** SLOOT. *ex* [ENDERT, M. O. Born. Exp. 1925 (1926) 261, 266, 267, 272, *nomen*] Foxw. Mal. For. Rec. 10 (1932) 214; ENDERT, *Tectona* 26 (1933) 410; DE VOGD, *ibid.* 26 (1933) 703; BOON, *ibid.* 32 (1939) 839; BURK, *Dict.* (1935) 2020; DESCH, *Mal. For. Rec.* 12 (1936) 2, 43, 63, 65; SYM. J. Mal. Br. R. As. Soc. 14 (1936) 336, 339, 340, 348; Gard. Bull. S. S. 10 (1939) 377; Mal. For. Rec. 16 (1943) 89, f. 38, 54; DESCH & THOMAS, *Mal. For. Rec.* 13 (1940) 4; SLOOT, *Bull. Bot. Gard. Btzig III*, 17 (1941) 110, f. 16; ASHTON, *Man. Dipt. Brun.* (1964) 212, f. 17,

pl. 47 (stem-base); *ibid.* Suppl. (1968) 115; MEIJER & WOOD, *Sabah For. Rec.* 5 (1964) 139; NG, *Mal. For.* 39 (1976) 91, f. 1–9.

Large tree with dark, flaky and fissured bark. Young parts grey puberulent, fugaceous except on stipule and panicle. *Twig* c. 3 by 1.5 mm  $\varnothing$  apically, compressed, glabrous, smooth; stipule scars c. 2 mm long, linear, pale, horizontal. *Leaf bud* to 4 by 1.5 mm  $\varnothing$  apically, compressed, acute. *Stipule* to 13 by 3.5 mm, hastate, acute. *Leaves* alternate, 6–9 by 2–3 cm, lanceolate; base cuneate and with revolute margin; acumen c. 1 cm long; margin undulate; nerves 15–18 pairs, slender, hardly elevated beneath,  $\pm$  obscure, with short secondary nerves running  $\frac{1}{2}$  way to margin; tertiary nerves very slender, densely scalariform, diagonal to nerves; midrib narrow, obscure and depressed above, slender but sharply prominent beneath; *petiole* 1–1.5 cm long, slender, compressed laterally. *Panicle* to 7 cm long, terminal or axillary, compressed; singly branched, branchlets to 1.8 cm long, bearing to 7 second flowers; *bracteoles* unknown. *Flower bud* to 8 by 3 mm, ovoid, ellipsoid. *Calyx* densely shortly puberulent outside, glabrous within; 3 outer lobes ovate, acuminate, 2 inner lobes smaller, more narrowly acuminate. *Petals* pale yellow, lanceolate, slender, acute, densely pubescent on parts exposed in bud. *Stamens* 15, of 2 lengths; filament broad at base, tapering  $\pm$  abruptly and filiform distally; anther subglobose; appendages to connective c.  $4 \times$  length of anther, slender, glabrous. *Ovary* and *stylopodium* pyriform, puberulent towards apex; style glabrous, as long as ovary and stylopodium. *Fruit calyx* glabrescent; 3 longer lobes to 10 by 1 cm, narrowly spatulate, obtuse, to 4 mm broad above the to 7 by 7 mm broadly ovate saccate thickened base; 2 shorter lobes to 5 by 0.4 cm, linear, acute, similar at base. *Nut* to 1.5 by 1 cm, glabrescent; style remnant acute.

Distr. *Malesia*: Sumatra, Borneo.

Ecol. Widespread in mountainous districts, usually between 700–1300 m, but occasionally down to 200 m in valley bottoms near mountains.

Vern. *Mēranti bukit, jalak* (Malaya).

Note. NG *l.c.* found that if the orthotropic leader shoot is damaged it is replaced by new orthotropic leaders from dormant accessory buds, not by lateral plagiotropic shoots.

**115. *Shorea scaberrima*** BURCK, *Med. Lands Pl.* Tuin 3 (1886) 22; Ann. Jard. Bot. Btzig 6 (1887) 208; BRANDIS, *J. Linn. Soc. Bot.* 31 (1895) 78; MERR. En. Born. (1921) 406; HEYNE, *Nutt. Pl. ed.* 1, 3 (1917) 306; *ibid.* ed. 2 (1927) 1124; BROWNE, *For. Trees Sarawak & Brunei* (1955) 143; ASHTON, *Man. Dipt. Brun.* (1964) 219, f. 17, pl. 49 (bark). — **Fig. 99 A–A4.**

Medium-sized tree. Young twigs, panicle, leaf bud, stipule outside (puberulent within), petiole, leaf beneath and midrib above densely persistent-scabrid tawny tomentose; leaf above fugaceous pubescent. *Twig* 2–3 mm  $\varnothing$  apically, terete, becoming rugulose, verrucose, much branched; stipule scars to 1.5 mm

long at first, 0.5 mm thick, shortly cuneate, obscured by tomentum. Bud 4–6 by 4–5 mm, broadly ovoid, slightly compressed, subacute. *Stipule* to 18 by 8 mm, broadly hastate, subacute, constricted at base, caducous. *Leaves* 7–20 by 4–9 cm, oblong-obovate to oblong-ovate, thinly coriaceous; base obtuse, rarely subcordate; acumen to 8 mm long, short, deltoid; nerves 14–17 pairs, rather slender, curved, at 40°–50°, more widely at base; tertiary nerves distinct, rather densely scalariform; midrib prominently terete beneath, slightly depressed or applanate above; *petiole* 1.8–2.5 cm long. *Panicle* to 8 cm long, short, lax, terminal or axillary, terete or ribbed; singly branched, the branchlets bearing to 3 ± second flowers; *bracteoles* to 4.5 by 3 mm, narrowly deltoid, acute, scabrid pale fulvous pubescent outside, puberulent within, fugaceous. *Flower bud* to 8 by 5 mm, ovoid, obtuse. *Calyx* densely yellow-brown pubescent; 3 outer lobes deltoid to ovate, frequently acuminate, acute; 2 inner lobes similar but smaller. *Petals* pink, narrowly lanceolate, densely setose on parts exposed in bud. *Stamens* 15, the 5 innermost somewhat longer than the other; filaments basally expanded, abruptly contracted and filiform distally; anther ± oblong; appendage to connective reaching the style apex on 5 inner stamens, more than twice as long as anther cells, becoming curved but not reflexed. *Ovary* subglobose, small, shortly densely pubescent; style and stylopodium 3 times as long as ovary, filiform with glabrous apex, swelling slightly below it and densely shortly pubescent; frequently further swollen in the basal half. *Fruit calyx* shortly evenly fulvous pubescent; 3 longer lobes to 4.5 by 1 cm or shorter, unequal, variable, shortly spatulate, subacute, to 7 mm broad above the to 2 by 3.5 cm broadly ovate shallowly saccate thickened base, closely adpressed to the base of nut; 2 shorter lobes to 3 by 0.3 cm, linear, similarly expanded at base. *Nut* to 5 by 2.5 cm large, obovoid, tapering to an acute apical style remnant, densely evenly fulvous pubescent, becoming the same length or slightly longer than the calyx.

Distr. *Malesia*: N.W. Borneo (through Sarawak to S.W. Sabah); S.E. Borneo (Puruktau, sterile collection?).

Ecol. Frequent, sandy clay soils on low hills, alluvium and locally on ridges and volcanic plateaux to 850 m.

Vern. *Engkabang bintang, kantoi, k. lilin, k. tēm-baga, tēntung, tēngkawang kijang* (W. Borneo), *mēr-anti paya, m. paya bērsisek* (Brunei), *ēngkabang pinang* (Iban), *sēraya mēmpelas* (Sabah).

**116. *Shorea fallax*** MEIJER, Act. Bot. Neerl. 12 (1963) 335, pl. 7; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 105; ASHTON, Man. Dipt. Brun. (1964) 186, f. 17; *ibid.* Suppl. (1968) 107. — *S. oleosa* MEIJER, Act. Bot. Neerl. 12 (1963) 338, pl. 8; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 124. — *S. squamata* (non BENTH. & HOOK. f.) BROWNE, For. Trees Sarawak & Brunei (1955) 144.

Medium-sized to large buttressed tree. Young twig,

panicle, leaf bud, stipule outside (glabrescent or shortly pubescent within), petiole beneath, leaf beneath and midrib above sparsely persistently pale brown scabrid tomentose. *Twig* 2–2.5 mm Ø apically, terete, ribbed below the stipule scars, becoming smooth; stipule scar c. 2 mm long, c. 0.5 mm thick, pale, cuneate, slightly falcate, horizontal or slightly ascending. *Leaf bud* 5–8 by 4–6 mm, ovoid, subacute. *Stipule* to 15 by 5 mm, hastate, acute. *Leaves* 12–24 by 5.5–11 cm, broadly oblong to ovate, ± thinly coriaceous; base obtuse; acumen to 1.2 cm long; nerves 15–19 pairs, prominent, at 60°–70°, curved distally; short secondary nerves frequently present; tertiary nerves prominent, well spaced, at 90° to nerves; midrib prominent, terete beneath, applanate but evident above; *petiole* 1–1.5 cm long, short. *Panicle* to 22 cm long, terminal or axillary, terete or ribbed, lax, regularly alternately singly or doubly branched, the branchlets bearing to 7 second flowers; *bracts* and *bracteoles* to 7 by 3 mm, ovate, acute, pubescent outside, glabrous within, not at first caducous. *Flower bud* to 8 mm long, narrowly ovoid, acute. *Calyx* shortly densely pale grey-brown pubescent outside, glabrous within; 3 outer lobes longer, ± deltoid to ovate, subacute; 2 inner lobes shorter, narrowly deltoid to ovate, acute, acuminate. *Petals* pale cream-yellow, narrowly oblong, densely pubescent on parts exposed in bud. *Stamens* 15, the 5 inner anther's length longer than the others; filaments basally expanded, abruptly tapering and filiform distally; anthers oblong; appendage to connective reaching to style apex on 5 inner stamens, more than twice as long as anthers, curved but not reflexed. *Ovary* and *stylopodium* pyriform, densely pubescent in the distal half, shortly densely pubescent basally; style as long as ovary and stylopodium, filiform, glabrous. *Fruit* subsessile. *Calyx* glabrescent; 3 longer lobes to 5 by 0.8 cm, spatulate, subequal, to 3.5 mm broad above the to 1.5 by 1.2 cm ovate glabrous shallowly saccate thickened base; 2 shorter lobes to 2.5 by 1.5 mm, linear, similar at base. *Nut* to 2.7 by 1.0 cm, ovoid, shortly buff pubescent, apiculate, shorter than longer calyx lobes.

Distr. *Malesia*: Borneo (N.E. Sarawak and Sabah to Berau).

Ecol. Widespread on clay soils in Mixed Dipterocarp forest, on well drained alluvium, undulating land and hillsides to 600 m.

Vern. *Engkabang layar, e. pinang* (Sar.), *mēntahun, mēranti sēpit undang* (Brun.), *sēraya minyak* (Sabah), *tuntong sēluang, kontoi* (S.E. Borneo).

Note. Doubtfully distinct from *S. parvistipulata* (see sub *ssp. albifolia*).

**117. *Shorea pubistyla*** ASHTON, Gard. Bull. Sing. 22 (1967) 297, pl. 43; Man. Dipt. Brun. Suppl. (1968) 116, f. 14, pl. 21 (bark). — **Fig. 102.**

Large tree. Twig, leaf bud, petiole and midrib beneath densely dark fulvous scabrid tomentose; more shortly, sparsely so on nervation beneath, midrib above and stipule outside; stipule within



evenly densely pale fulvous caducous pubescent. *Twig* c. 7 mm  $\varnothing$  towards the apex, stout, prominently ribbed at first, becoming terete; stipule scars c. 2 mm long, horizontal, obscure. *Bud* to 1.3 mm long and  $\varnothing$ , ovoid, compressed. *Stipule* to 2.5 by 0.7 cm, lanceolate, subcaudate, caducous. *Leaves* 11–19 by 7–12 cm, broadly oblong to obovate, thickly coriaceous; base obtuse to cordate; apex obtuse, subretuse or shortly acuminate; nerves 14–18 pairs, obscurely depressed above, prominent beneath, at  $110^\circ$  at the base,  $45^\circ$  at the apex; tertiary nerves remotely scalariform, prominent beneath; *petiole* 2.5–4 cm long, stout. *Panicle* to 20 cm long, ribbed, densely shortly fulvous scabrid tomentose, lax, axillary; singly branched, branchlets to 6 cm long, bearing to 12 second flowers; *bracteoles* to 8 by 5 mm, oblong-ovate, subacute, shortly evenly caducous pubescent. *Flower bud* to 7 by 3 mm, lanceolate. *Sepals* densely pubescent; 3 outer ovate, acute, 2 inner ovate, thinner at the fimbriate margins, narrower at base, than the outer 3. *Petals* pink outside, crimson within, elliptic-lanceolate, pubescent on parts exposed in bud. *Stamens* 15, the inner 5 slightly longer than the outer 10 and reaching the style apex at anthesis; filaments broad and compressed at base, tapering abruptly medially and filiform below the broadly ellipsoid anthers; appendage to connective slender, 2–3 times length of anther, glabrous. *Ovary* ovoid, densely pubescent, crowned by a somewhat longer stoutly columnar densely pubescent stylopodium and short glabrous style. *Fruit pedicel* to 3 mm long, to 3 mm  $\varnothing$ , stout. *Fruit calyx* at first sparsely pubescent towards base, becoming entirely glabrous; 3 longer lobes to 14 by 2.5 cm, spatulate, obtuse, c. 8 mm broad above the to 1.3 by 1.4 cm broadly ovate saccate thickened base; 2 shorter lobes to 12 by 1.2 cm, lorate, obtuse, otherwise as in longer lobes. *Nut* to 3 by 1.8 cm, narrowly ovoid, densely shortly evenly pale cream-brown pubescent; stylopodium to 4 mm long, apiculate.

Distr. *Malesia*: N.W. Borneo (W. and Central Sarawak).

Ecol. Scattered on leached clay soils on low hills in Mixed Dipterocarp forest.

Vern. *Mēranti bulu merah*.

**118. *Shorea palosapis*** (BLCO) MERR. Sp. Blanc. (1918) 271; En. Philip. 3 (1923) 98; REYES, Philip. J. Sc. 22 (1923) 325. — *Dipterocarpus palosapis* BLCO, Fl. Filip. ed. 2 (1845) 312; *ibid.* ed. 3, 2 (1878) 214; DC. Prod. 16, 2 (1868) 614; DYER, J. Bot. 12 (1874) 108. — *Hopea squamata* TURCZ. Bull. Soc. Nat. Mosc. 31 (1858) 239; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7 (1868) 379. — *S. squamata* BENTH. & HOOK. f. [Gen. Pl. 1 (1862) 193] ex DC. Prod. 16, 2 (1868) 632; VIDAL, Phan. Cuming. (1885) 97; Rev. Pl. Vasc. Filip. (1888) 62; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 92; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 267; MERR. Philip. J. Sc. 2 (1907) Bot. 285; FOXW. Philip. J. Sc. 2 (1907) Bot. 386; MERRITT, Bull. Bur. For. Philip. 8 (1908) 16, 48; FOXW. Philip. J. Sc. 4 (1909) Bot. 519; WHITFORD, *ibid.* 4 (1910) Bot. 715;

Bull. Bur. For. Philip. 10 (1911) 66; FOXW. Philip. J. Sc. 6 (1911) Bot. 275; in Elmer, Leaf. Philip. Bot. 6 (1913) 1957; Philip. J. Sc. 13 (1918) Bot. 191; MERR. En. Born. (1921) 407; FOXW. Philip. J. Sc. 67 (1938) 310. — *S. floribunda* (non KURZ) F.-VILL. Nov. App. (1880) 21. — *S. rugosa* (non HEIM) FOXW. Philip. J. Sc. 13 (1918) Bot. 191.

Large buttressed tree. Midrib and nerves above, branchlets of panicle, bracteoles, ovary and parts of petals exposed in bud  $\pm$  densely persistently cream puberulent; calyx at first so, becoming sparse, glabrescent; twigs, buds, bracts, stipules, petioles and nervation beneath  $\pm$  sparsely persistently scabrid pubescent. *Twig* 2–3 cm  $\varnothing$  apically, rather stout, ribbed, becoming terete, smooth; stipule scars pale, distinct, amplexicaul. *Bud* to 15 by 10 mm, ovate, acute, compressed. *Stipules* to 1.5 by 11 mm, ovate-auriculate, prominent, not at first caducous. *Leaves* 12–24 by 8–11 cm, large, oblong, thinly coriaceous; base  $\pm$  shallowly cordate or sometimes obtuse; apex obtuse or to 2 cm long slender acuminate (young trees); nerves 14–19 pairs, prominent beneath,  $\pm$  depressed above as also the midrib and tertiary nerves, set at c.  $45^\circ$  towards the apex, at c.  $90^\circ$  at the base, usually with short less prominent secondary nerves; tertiary nerves remotely scalariform; *petiole* 1.5 to 2.5 cm long, rather stout. *Panicles* to 25 cm long, terminal or subterminal axillary, stout, spreading, many-flowered, singly (if axillary) or doubly branched; branchlets to 3 cm long, bearing to 8 flowers; *bracts* as stipules but somewhat smaller, *bracteoles* to 6 by 3 mm, elliptic, subacute, neither at first caducous. *Flower bud* to 6 by 3 mm, fusiform. *Sepals* narrowly ovate; outer 3 acute, inner 2 slightly shorter, prominently acuminate. *Stamens* 15, unequal, slightly shorter than style at anthesis; filaments broadly compressed at base, abruptly tapering and filiform distally; appendages slender, glabrous,  $3-4 \times$  length of the subglobose anthers. *Ovary* and *stylopodium* pyriform, densely pubescent; style somewhat shorter, filiform, glabrous. *Fruit pedicel* to 2 mm long, stout; 3 longer *calyx lobes* to 12(–17) by 1.5 cm, spatulate, coriaceous, obtuse, c. 6 mm broad above the to 12 by 10 mm ovate saccate thickened base; 2 shorter lobes to 3.5 by 0.3 cm, linear, similar at base; *nut* to 23 by 14 mm, ovoid, acute.

Distr. *Malesia*: Philippines.

Ecol. Widespread, often abundant, in lowland evergreen Mixed Dipterocarp forest on fertile well-drained soils in non-seasonal areas below 300 m.

Vern. *Mayápis*, *tabak* (Tag.), *purá* (Bik.), *kalián* (Lan.), *alam* (Tag., Mang.).

**119. *Shorea bullata*** ASHTON, Gard. Bull. Sing. 19 (1962) 283, pl. 15; Man. Dipt. Brun. (1964) 181, f. 17; *ibid.* Suppl. (1968) 105.

Medium-sized tree with golden brown cracked and patchily flaked bark. Outside of stipule, twig, panicle, petiole and nervation beneath persistently scabrid fulvous pubescent; more densely tomentose on leaf buds and midrib above; caducous hispid on lamina above; shortly pubescent on stipule within. *Twig* c. 2

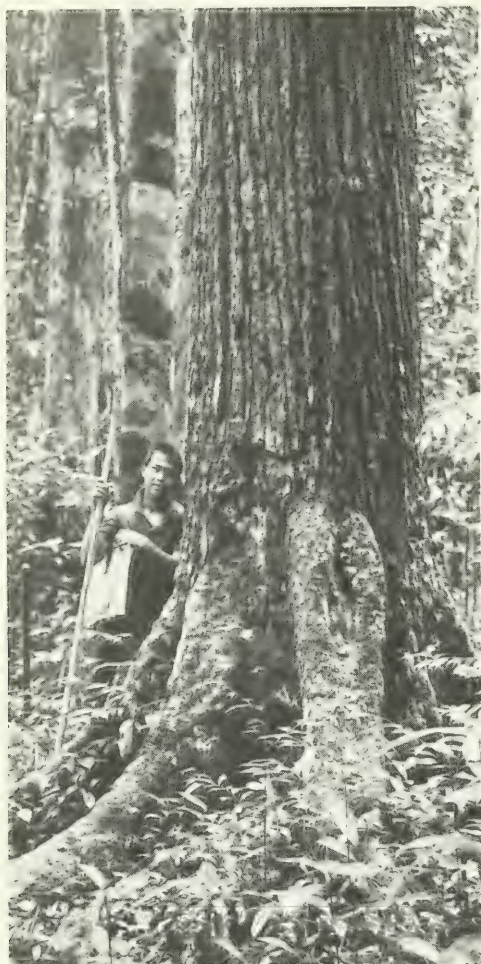


Fig. 102. Trunk of *Shorea pubistyla* ASHTON. Sarawak, Semengoh Arboretum (Photogr. ASHTON).

mm  $\varnothing$  apically, becoming thinly papery flaked, terete, much branched; stipule scars short, horizontal, obscured by tomentum. *Bud* 3–4 by 2–3 mm, broadly ovoid. *Stipule* to 7 by 2 mm, narrowly hastate, acute. *Leaves* 6.5–10 by 3–4.5 cm, chartaceous, frequently cupped, elliptic to oblong-ovate; base narrowly obtuse or broadly cuneate; apex obtuse or with to 5 mm long short acumen; margin usually revolute; nerves 10–12 pairs; tertiary nerves well spaced, scalariform, at 90° to nerves; nervation depressed above; *petiole* 0.8–1 cm long, short. *Panicle* to 11 cm long, terminal or axillary, terete, lax, regularly singly (or doubly if terminal) branched; branchlets to 3.5 cm long, bearing to 8  $\pm$  secund flowers; bracts unknown; *bracteoles* to 6 by 3.5 mm, broadly elliptic, obtuse,

pale grey puberulent. *Flower bud* to 15 by 3 mm, fusiform, obtuse. *Calyx* small, densely pale greyish pubescent outside, glabrous within; lobes subequal, broadly ovate to suborbicular. *Petals* pale cream pink at base, linear, obtuse, densely pubescent on parts exposed in bud, loosely adhering on falling. *Stamens* 15, congested, the 5 inner longer by an anthers length, the outer 10 subequal; filaments connate at base, broad, tapering abruptly and filiform distally; anthers oblong; appendages to connective to 4 times length of anther, exceeding style apex, very slender, twisted. *Ovary* and *stylopodium* ovoid, densely shortly pubescent; style almost twice their length, the basal half thickened and setose. *Fruit calyx* persistently sparsely pale buff pubescent at base, glabrescent towards apex; 2 longer lobes to 9 by 1.3 cm, spatulate, obtuse, to 5 mm broad above the to 6 by 6 mm prominently saccate thickened base; 2 shorter lobes to 5 by 3 mm, linear, obtuse, similar at base. *Nut* to 10 by 7 mm, ovoid, shortly densely cream pubescent, acute.

Distr. *Malesia*: Northern Borneo (N.E. Sarawak, Brunei).

Ecol. Rare, yellow sandy soils in Mixed Dipterocarp forest below 800 m.

Vern. *Mĕranti mĕlechor*.

**120. *Shorea flaviflora* WOOD** ex ASHTON, Gard. Bull. Sing. 19 (1962) 289, pl. 18; Man. Dipt. Brun. (1964) 188, f. 17; *ibid.* Suppl. (1968) 108; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 107. — Fig. 100 C–C2.

Medium-sized tree, often misshapen. Young parts shortly pale grey pubescent with minute adpressed hair tufts, caducous except on panicle, leaf bud and stipule. *Twig* 2–3 mm  $\varnothing$  apically, terete, glabrous, smooth, pale brown; stipule scars 1.5–2 mm long at first, narrow, ascending, half encircling twigs. *Bud* 6–12 by 1.5–3 mm, acute, falcate. *Stipule* to 24 by 7 mm, narrowly hastate, acute, fugaceous. *Leaves* 12–18 by 5.5–7 cm, thinly coriaceous, narrowly ovate; base obtuse or broadly cuneate; acumen to 1.5 cm long, slender; nerves 6–7 pairs, curved, well spaced, slender, prominent beneath, at *c.* 40°–50°, with small axillary domatia; midrib applanate above, prominent beneath; tertiary nerves very slender, diagonal to nerves, densely scalariform; *petiole* 2–3 cm long. *Panicle* to 15 cm long, terminal or axillary, pendent, terete, rugose on drying; doubly branched at to 3 cm intervals, the branchlets bearing to 12 distichous flowers; *bracteoles* to 5 by 2.5 mm, elliptic, obtuse, densely shortly pale grey pubescent outside, sparsely pubescent within. *Flower bud* to 14 by 4.5 mm, large, fusiform, obtuse. *Calyx* glabrous but for the setose margin: lobes equal, broadly ovate, thickened, closely adpressed at the corolla. *Petals* rich yellow, narrowly lanceolate, acute, firmly connate at base, strongly contorted and twisted, imbricate, the basal half forming a broad cup when open, shortly pubescent on parts exposed in bud. *Stamens* 15, of 3 distinct lengths; filaments expanded at base, abruptly tapering and filiform distally; anthers large, reniform, cells indistinct; appendage to connective *c.* 3  $\times$  length of anther,



the longest reaching half length of style. *Ovary* and *stylopodium* pyriform, shortly densely pubescent; style as long as ovary and stylopodium, filiform, glabrous. *Fruit calyx* glabrous; 3 longer lobes to 13 by 3 cm, broadly spatulate, obtuse, to 11 cm broad above the to 1.0 by 1.2 cm deeply saccate thickened base; 2 shorter lobes to 8 by 1.3 cm, subequal, similarly saccate. *Nut* to 2.5 by 1.3 cm, ovoid, shortly densely buff pubescent; stylopodium to 1 cm long, tapering.

Distr. *Malesia*: N. Borneo (Rejang hinterland, Crocker Range and Kinabalu).

Ecol. High hill ridges (150–)400–1300 m; locally common.

Vern. *Sēlangan mērah bukit* (Brunei), *sēraya daun bēsar* (Sabah).

**121. *Shorea monticola*** ASHTON, Gard. Bull. Sing. 19 (1962) 297, pl. 22; Man. Dipt. Brun. (1964) 200, f. 17; *ibid.* Suppl. (1968) 111; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 121.

Medium-sized or relatively large tree. Young twig, leaf bud, petiole and nervation at first shortly yellowish buff pubescent, caducous on all but bud. *Twig* to 3 mm  $\varnothing$  apically, stout, terete, becoming smooth but for the minute pale elliptic warty lenticels; stipule scars subamplexicaul or amplexicaul, pale, prominent. *Bud* 5–10 by 2–4 mm, narrowly ovate, acute, falcate. *Stipule* unknown. *Leaves* 8–13 by 5–8 cm, thickly coriaceous, elliptic; undersurface golden lepidote at first, becoming mauve-grey; base obtuse or broadly cuneate; acumen to 5 mm long, short, broad; nerves 13–16 pairs, prominent beneath, curved towards margin, at 45°–55°; tertiary nerves slender, densely scalariform, diagonal to nerves; midrib stout, prominent, sharply ridged beneath, obscurely depressed above; *petiole* 2–2.5 cm long. *Panicle* to 12 cm long, terminal or axillary, terete, densely pale tawny pubescent; singly branched, branchlets bearing to 12 distichous flowers. *Bracts* and *bracteoles* unknown. *Flower bud* to 7 by 3 mm, lanceolate, subacute. *Calyx* shortly pubescent outside, glabrous within; 3 outer lobes narrowly ovate, obtuse; 2 inner lobes *c.*  $\frac{2}{3}$  as long, broader, ovate, acute, constricted at base. *Petals* oblong, obtuse, shortly pubescent on parts exposed in bud. *Stamens* 15, in 3 verticils, the inner 5 somewhat longer than the rest; filaments exposed in bud, broad at base, tapering abruptly, filiform distally; anthers broadly oblong; appendage to connective 2–3 times length of anther, slender. *Ovary* and *stylopodium* pyriform, shortly pubescent; style as long as ovary, filiform, glabrous. *Fruit calyx* puberulent at base, otherwise glabrous; 3 longer lobes to 7 by 1.5 cm, spatulate, obtuse, only slightly tapering above the to 1.5 by 1.5 cm shallowly saccate thickened base; 2 shorter lobes to 3.5 by 0.6 cm, narrowly oblong, similar at base. *Nut* to 1.6 by 1 cm, ovoid, shortly acute, densely shortly pubescent.

Distr. *Malesia*: N. Borneo (West Borneo to Kinabalu and Trusmadi).

Ecol. Mountains, between 1000–1500 m; locally common.

Vern. *Mēranti gunong* (Brunei), *sēraya gunong* (Sabah).

**122. *Shorea kunstleri*** KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 116; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 154, t. 186; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 93; RIDL, Fl. Mal. Pen. 1 (1922) 228; FOXW. Mal. For. Rec. 3 (1927) 51; *ibid.* 10 (1932) 204; BURK. Dict. (1935) 2012; SYM. Mal. For. Rec. 16 (1943) 72, f. 38, 44; BROWNE, For. Trees Sarawak & Brunei (1955) 154; ASHTON, Man. Dipt. Brun. (1964) 192, f. 17, pl. 50 (habit, bark); *ibid.* Suppl. (1968) 109; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 109.

Large buttressed tree. Young parts shortly pale buff puberulent,  $\pm$  caducous on twig, petiole and leaf, more dense and persistent on panicle, leaf bud and stipule outside (sparse within). *Twig* *c.* 2 mm  $\varnothing$  at apices, much branched, ribbed at first, becoming terete, smooth or rugulose; stipule scars  $\pm$  horizontal, *c.* 2 mm long, cuneate, cream-grey. *Bud* 5–7 by 2–2.5 mm, falcate. *Stipule* to 1.2 by 0.4 cm, narrowly lanceolate, acute, fugaceous. *Leaves* 8–12 by 4.5–7 cm, broadly ovate, coriaceous, frequently twisted to one side, normally glabrous (rarely pubescent); base obtuse or broadly cuneate; acumen to 1 cm long; nerves 6–8 pairs, slender, hardly raised beneath, curved, at *c.* 50°–60°, with or without minute axillary domatia; midrib appanate; tertiary nerves slender, scalariform, at 90° to midrib; *petiole* 2–3.5 cm long. *Panicle* to 15 cm long, terminal (rarely axillary), slender, slightly compressed on drying; regularly singly or doubly branched, the branchlets lax, bearing to 9 second flowers; *bracteoles* to 5 by 3.5 mm, elliptic, obtuse, shortly densely pale greyish pubescent. *Flower bud* to 9 by 3 mm, narrowly ovoid-lanceolate, acute. 3 outer *sepals* longer, deltoid, acuminate; 2 inner ovate, acuminate. *Corolla* pale yellow, pink at base, shortly pubescent on parts exposed in bud; petals narrowly lanceolate, obtuse, twisted, slightly saccate. *Stamens* 15, the inner 5 only slightly longest; filaments expanded at base, narrowing abruptly distally; anthers broadly oblong; appendage to connective more than twice length of anther, the inner 5 reaching almost to style apex. *Ovary* and *stylopodium* pyriform, shortly pubescent; style filiform, glabrous but for the sparsely pubescent base, somewhat shorter than ovary. *Fruit calyx* entirely glabrous; 3 longer lobes to 8.5 by 1.8 cm, spatulate, narrowly obtuse, *c.* 5 mm broad above the *c.* 1.2 cm long and broad strongly saccate thickened base; 2 shorter lobes to 4 by 0.4 cm, unequal, linear, similarly saccate at base. *Nut* to 2 by 1.5 cm, ovoid, densely shortly buff pubescent; style remnant *c.* 3 mm long, conical.

Distr. *Malesia*: Malaya (Perak and E. coast), N. Sumatra (Langsa, Atjeh), Borneo (Lower Kapuas, West Borneo; Sarawak; E. Sabah and S.E. Borneo to Sampit).

Ecol. Local on infertile leached sandy clay soils on low hills and ridges, rarely to 800 m; on ultrabasics in Sabah.

Vern. *Damar laut mērah*, *mēranti pahang*, *sēlimbar*,

Revel  
1977

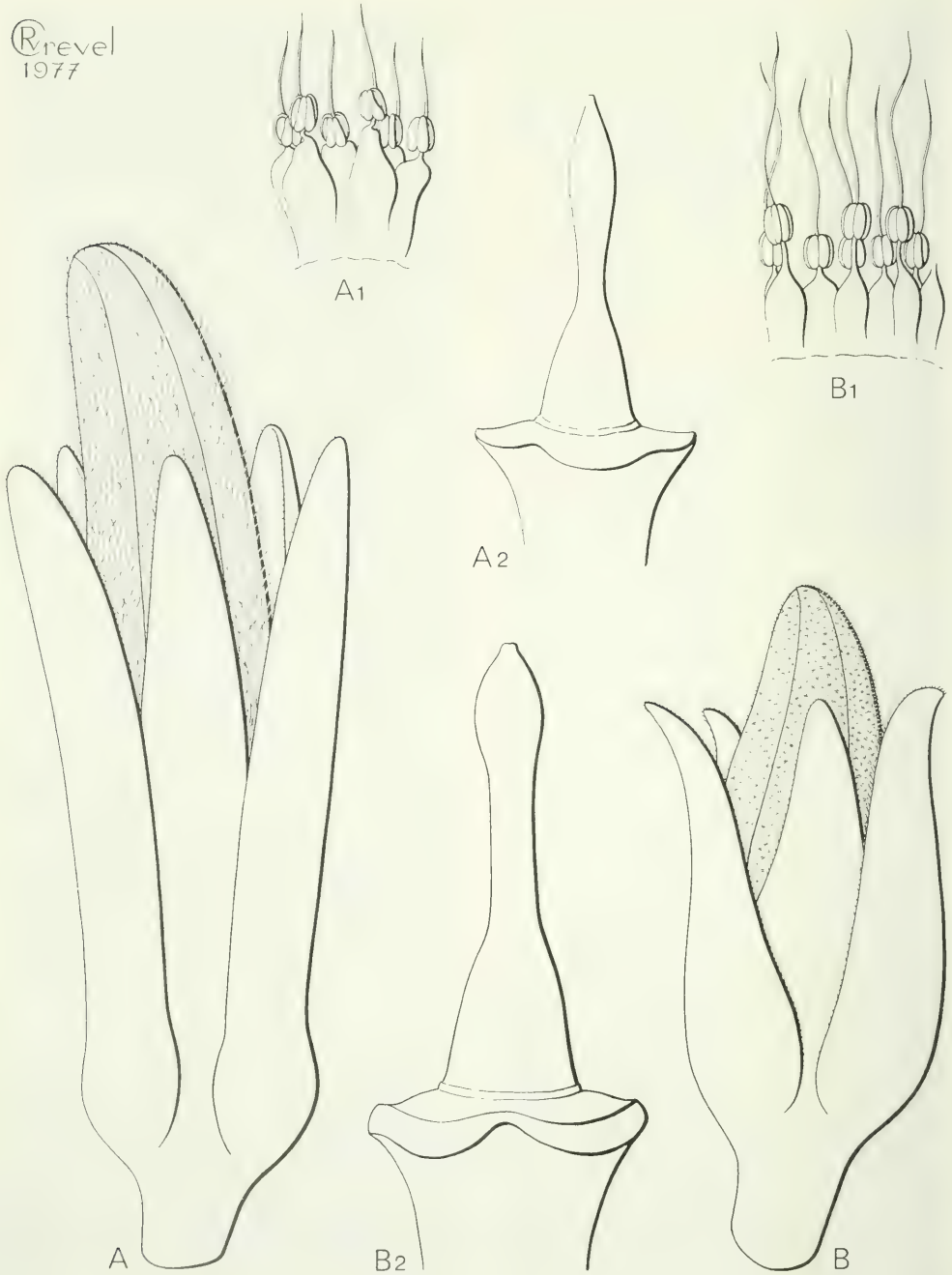


Fig. 103. Flower details in *Shorea* sect. *Pachycarpae* HEIM. All  $\times 10$ . — *S. pinanga* SCHEFF. A. Bud, A1. stamens from inside, A2. pistil. — *S. rotundifolia* ASHTON. B. Bud, B1. stamens from inside, B2. pistil (A JACOBS 5330, B S 29226).



tēngkawang bukit, t. batu, tērbak, sēraya, s. kitan, balau mērah (Malaya).

Note. Collections from the Kapuas valley differ in

having the lamina somewhat bullate between the nerves, which are slightly more numerous and more ascending than in the type.

### 8. Section Pachycarpae

HEIM. Rech. Dipt. (1892) 44; ASHTON. Gard. Bull. Sing. 20 (1963) 269 (*Pachycarpa*); Man. Dipt. Brun. (1964) 118. — *Shorea* sect. *Pinanga* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 90. — **Fig. 103, 104.**

*Flower buds* ovoid or fusiform; corolla as in sect. *Rubella*: *stamens* 15, in 3 subequal verticils; filaments lorate, adnate along their margins thus forming a tube round the ovary, tapering  $\pm$  abruptly below the anthers; anthers subglobose or broadly oblong; appendage to connective filiform, slender, glabrous, erect, 2– $\infty$  times length of anther; *ovary* small, glabrescent or glabrous; style filiform, stylopodium indistinct, or both spindle-shaped, tapering distally and basally, 3 outer *fruit calyx lobes* lorate, broad at base. *Stipules*, *bracts* and *bracteoles* persistent, large. *Leaf* with scalariform tertiary nerves; midrib above evident,  $\pm$  depressed. Small or large stoutly buttressed trees. Bark surface remaining smooth and hoop-marked longer than in other sections, later becoming  $\pm$  flaky, sometimes scroll marked. *Wood* as in sect. *Brachypterae*.

Distr. *Malesia*: Borneo.

Ecol. In lowland forest below 1200 m.

Vern. *Langgai*, *ēngkabang* (Iban, Sarawak), *tēngkawang*, *abang*.

Note. Flowers of *S. splendida* and *S. stenoptera* are visited by small *Hymenoptera* as well as thrips (S. APPANAH) and are thought to be pollinated by them. The only uniform and constantly distinguishable widespread species is *S. mecistopteryx*; all others exhibit much geographical variability, with high uniformity within populations nevertheless, and apparent hybridization with one or more species in some part of their range. Embryogenesis appears to be normal, self-incompatibility high (CHAN H. T.) and the group appears therefore to be undergoing active speciation.

**123. *Shorea pilosa*** ASHTON, Gard. Bull. Sing. 19 (1962) 304, pl. 25; Man. Dipt. Brun. (1964) 209, f. 18, pl. 55 (slash, bark); *ibid.* Suppl. (1968) 115; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 136.

Medium-sized to large tree. Twig, leaf bud, petiole, both surfaces of midrib, leaf beneath and panicle densely persistently scabrid gold tomentose; leaf above puberulent or glabrescent. *Twig* 2–2.5 mm  $\varnothing$  apically, slightly compressed, becoming terete, much branched; stipule scars narrow, almost horizontal, amplexicaul. *Leaf bud* 3–7 by 1.5–3 mm, ovoid, obtuse or subacute. *Stipule* to 3.5 by 1.3 cm, hastate, acute; base slightly constricted; relatively persistent. *Leaves* 10–17 by 4–7.5 cm, ovate or elliptic, somewhat coriaceous; base obtuse; acumen to 1.3 cm, long, narrow; margin frequently narrowly revolute; nerves 12–15 close slightly curved pairs, at 45°–50°, with hispid axillary domatia; tertiary nerves densely scalariform, at c. 90° to the nerves; *petiole* 1–1.3 cm long, short. *Panicle* to 14 cm long, singly branched, terminal or axillary, terete. *Flower bud* to 8 by 3 mm, lanceolate. *Sepals* narrowly deltoid, subequal, densely pubescent on parts exposed in bud. *Petals* cream tinted with

pink, lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, the inner 5 slightly the longest; filaments compressed, connate, abruptly tapering below the broadly ellipsoid anthers; appendage to connective aristate, c. 4  $\times$  length of anthers. *Ovary* ovoid, glabrous; style and stylopodium spindle-shaped, glabrous. *Fruit calyx* glabrescent; 3 longer lobes by 17 by 2.5 cm, subequal, oblong-spatulate, obtuse, c. 1.3 cm broad above the c. 1.3 by 1.5 cm thickened deeply saccate base, adpressed to and hiding the nut; 2 shorter lobes to 12 by 1 cm, spatulate, similar at base. *Nut* to 2 by 1.8 cm, ovoid, abruptly constricted below the to 1 cm long narrow-conical apex; style remnant acute, densely shortly buff pubescent.

Distr. *Malesia*: N.W. Borneo (Kapuas hinterland, W. Borneo, to W. Sabah).

Ecol. Local, on sandy clay soils on undulating land and low hills.

Vern. *Kawang bulu* (Brun.), *langgai* (Iban).

Note. Collections from Sabah and Brunei differ in their distinctly buff tomentum and prominent tomentose leaf domatia. Those from W. Borneo could be interpreted as a hybrid with *S. amplexicaulis*.

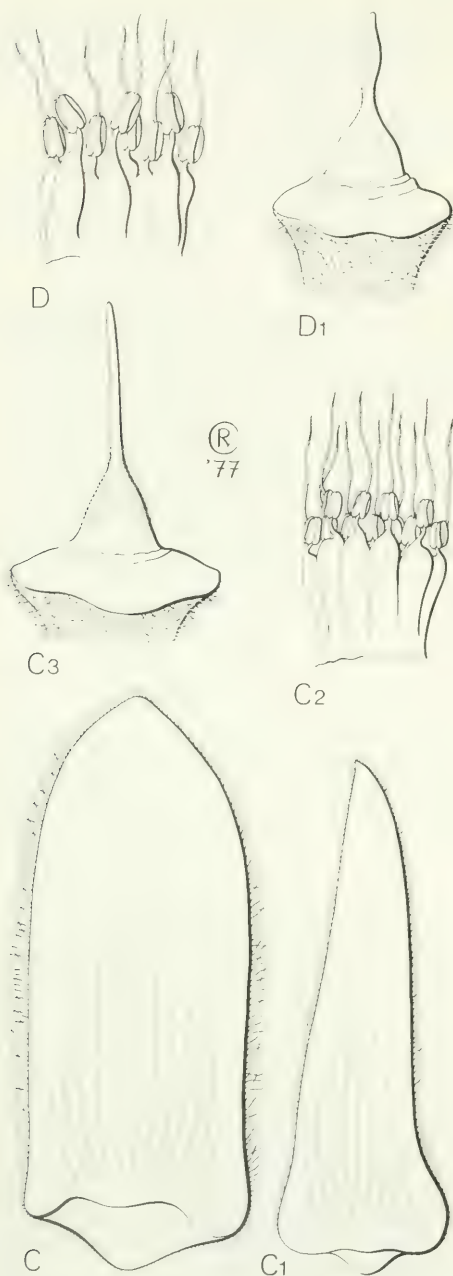


Fig. 104. Flower details in *Shorea* sect. *Pachycarpae* HEIM. All  $\times 10$ . — *S. beccariana* BURCK. C. Outer sepal, C1. inner sepal, both from inside, C2. stamens from inside, C3. pistil. — *S. macrophylla* (DE VRIESE) ASHTON. D. Stamens from inside, D1. pistil (C JACOBS 5563, D bb. 29722).

**124. *Shorea splendida* (DE VRIESE) ASHTON**, Gard. Bull. Sing. 20 (1963) 279; Man. Dipt. Brun. Suppl. (1968) 119, f. 15. — *Hopea splendida* DE VRIESE, Minjak Tengkawang (1861) 28. — *S. martiniana* SCHEFF. Nat. Tijd. N. I. 32 (1873) 408; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 208, t. 29, f. 2; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 78; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 306; MERR. En. Born. (1921) 405; HEYNE, Nutt. Pl. ed. 2 (1927) 1123; BACKER & BAKH. f. Fl. Java 1 (1963) 331; BROWNE, For. Trees Sarawak & Brunei (1955) 140.

Small to medium-sized tree. Vegetative parts glabrous. Twig c. 3 by 1 mm  $\varnothing$  apically, smooth, compressed, ribbed; stipule scars to 1 mm thick, prominent, amplexicaul, pale. Bud c. 8 by 6 mm, a loose aggregation of young leaves and stipules. Stipule to 2.5 by 1.5 cm, prominent, subpersistent, ovate, acute or subacute, with cordate subequal base. Leaves 8.5–23 by 4.2–11 cm, oblong, chartaceous, undulate,  $\pm$  lustrous; base typically cordate, sometimes obtuse or broadly cuneate; acumens to 1 cm long; nerves 9–12 pairs, slender but prominent beneath, at  $45^{\circ}$ – $65^{\circ}$  to the midrib; tertiary nerves sinuous, remotely scalariform, vertical to the nerves; midrib prominent beneath, applanate above; petiole 11–22 mm long, drying rugose. Panicle to 20 cm long, terminal or axillary, glabrous, terete, ascending; singly branched, branchlets to 7 cm long, bearing to 10 flowers; bracts to 18 by 8 mm, as stipules, caducous; bracteoles to 6 by 4 mm, elliptic, obtuse, subpersistent, prominent. Flower bud to 10 by 3 mm, lanceolate. Sepals narrowly deltoid, acute, subequal, sparsely pubescent on parts exposed in bud. Petals lanceolate, sparsely pubescent on parts exposed in bud. Stamens 15, the inner 5 longer than the outer 10; filaments compressed and connate along  $\frac{3}{4}$  of their length, abruptly tapering below the broadly ellipsoid anthers; appendage to connective 4–5 times length of anthers, almost reaching style apex, slender, sericeous in the distal  $\frac{1}{2}$ . Ovary ovoid, glabrous; style and stylopodium spindle-shaped, glabrous. Fruit pedicel to 7 mm long, to 4 mm  $\varnothing$ , large. Calyx glabrous; 3 major lobes to 7.5 by 2.3 cm, narrowly oblong to broadly spatulate, c. 12 mm broad above the to 22 by 18 mm ovate saccate thickened base; 2 inner lobes to 6.5 by 1.2 cm, as long as or somewhat exceeding the nut, oblong, similar at base. Nut to 5.5 by 3 cm, ovoid, acute, shortly densely evenly pale buff pubescent.

Distr. *Malesia*: Borneo (Kapuas valley, Sarawak west of the Lupar; Muara Tewe, planted?).

Ecol. Frequent, locally abundant, on clay-rich periodically flooded alluvium, sometimes planted.

Uses. An important producer of Borneo illipe fat (buah tēngkawang).

Vern. Tēngkawang, t. rambai (W. Borneo), mēlindang, t. lēmying (Muara Tewe), ēngkabang rambai (Sarawak).

Notes. Though variable, the leaf shape and broad, cordate, subpersistent stipules make this species generally easy to recognize; possibly occasionally hybridizing with *S. pinanga*.



Some populations in Kapuas appear to hybridize with *S. stenoptera*.

**125. *Shorea stenoptera*** BURCK, Med. Lands Pl. Tuin 3 (1886) 11; Ann. Jard. Bot. Btzg 6 (1887) 209, t. 21; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 78; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 264; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 308; MERR. En. Born. (1921) 407; GILG in E. & P. Pfl. Fam. ed. 2, 21 (1925) 260; HEYNE, Nutt. Pl. ed. 2 (1927) 1113, 1125; BROWNE, For. Trees Sarawak & Brunei (1955) 144; ASHTON, Man. Dipt. Brun. Suppl. (1968) 120, f. 15.

Small tree. Twig apex, petiole and midrib above sometimes densely ocherous pubescent (immature tree?), more commonly glabrous; stipule outside occasionally sparsely pubescent. Twig 3–4 mm  $\varnothing$  apically, somewhat compressed to terete, becoming smooth; stipule scars pale, prominent, descending, amplexicaul. Bud 4 by 3 mm, ellipsoid, obtuse, usually obscured by stipules. Stipule to 2 by 1 cm, ovate, deltoid, obtuse, subauriculate at base, subpersistent. Leaves 18–40 by 8–22 cm, large, oblong, thickly coriaceous; base broadly cuneate to cordate; acumen to 2 cm long,  $\pm$  prominent; nerves 10–14 pairs, stout, prominent, beneath, at 45°–60° along the midrib, to 110° near its base; tertiary nerves remotely scalariform; midrib evident but appanate above, prominent and terete beneath; petiole 2.3–4.5 cm long, stout. Panicle to 35 cm long, terminal or axillary, glabrous or (rarely) sparsely pubescent towards the base; borne behind the twig apices in the axils of fugaceous rudimentary leaves, a chain of short internodes being concealed in a dense profusion of the straight terete inflorescences with ascending branchlets; branchlets to 10 cm long; bracts and bracteoles to 6 by 4 mm, identical, ovate, acute, glabrous, not at first caducous. Flower bud to 7 by 3 mm, lanceolate. Sepals deltoid, acute, densely pubescent outside, sparsely so within; inner 2 smaller, relatively narrower than outer 3. Petals deep pink, lanceolate, sparsely pubescent on parts exposed in bud. Stamens 15, the inner 5 somewhat longer than the others and exceeding the style apex; filaments compressed, lorate, connate at margins along  $\frac{3}{4}$  of their length, tapering abruptly below the ellipsoid anthers; appendage to connective slender, 3–4  $\times$  length of anther, sericeous towards the apex. Ovary narrowly ovoid, glabrous; style and stylopodium spindle-shaped, slender, glabrous. Fruit pedicel to 4 mm long and  $\varnothing$ , prominent. Calyx glabrous; 3 longer lobes to 7.5 by 2 cm, spatulate, obtuse, to 1 cm broad above the to 2.5 by 2 cm ovate thickened saccate base; 2 shorter lobes to 5.5 by 0.8 cm, lorate-spatulate, obtuse, similar at base. Nut to 5 by 3 cm, ovoid, apiculate, large, densely shortly evenly buff pubescent.

Distr. *Malesia*: Borneo (Kapuas valley, Sarawak west of the Saribas; Muara Tewe, planted?).

Ecol. Locally common on  $\pm$  poorly drained sandy soils on alluvium and plateaux at low altitudes.

Vern. *Tengkawang layar*, *t. tungkul*, *t. rambai*, *t. tajan*, *t. tēlur* (W. Borneo), *ēngkabang rusa* (Sarawak).

Notes. A remarkably variable species. Sometimes a big tree, when it may differ from *S. macrophylla* only in the glabrous midrib and could be a hybrid. Usually small, but even then differing greatly between provenances; in West Sarawak the inflorescences are always axillary, born in groups between short internodes and subtended by modified or no leaves.

Some cultivated plants at Kepong flower almost annually, while one of the provenances planted at Haurbentes in West Java flowers almost continuously; it is said that the wild parents of the latter also did so.

**126. *Shorea macrophylla*** (DE VRIESE) ASHTON, Gard. Bull. Sing. 20 (1963) 278; Man. Dipt. Brun. (1964) 196, f. 18, 20; *ibid.* Suppl. (1968) 110, pl. 22 (illipe nuts); MEIJER & WOOD, Sabah For. Rec. 5 (1964) 156. — *Hopea macrophylla* DE VRIESE, Minjak Tengkawang (1861) 28. — *S. gysbertsiana* BURCK, Med. Lands Pl. Tuin 3 (1886) 15; Ann. Jard. Bot. Btzg 6 (1887) 211, t. 23, 30, f. 2–3, *incl. var. scabra* BURCK, *l.c.*, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 93; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 301; MERR. En. Born. (1921) 405; HEYNE, Nutt. Pl. ed. 2 (1927) 1113, 1114, 1119; FISCHER, Kew Bull. (1932) 177; BROWNE, For. Trees Sarawak & Brunei (1955) 139; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 45, 108, 156, f. 1d. — *S. bakeriana* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 974; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 96; MERR. En. Born. (1921) 404. — *Pachychlamys gysbertsiana* RIDL. Fl. Mal. Pen. 1 (1922) 233 (*'gysbertiana'*). — **Fig. 104 D–D1.**

Medium-sized to large tree. Young twig, leaf bud, stipules, petiole, leaf beneath and midrib above persistently densely evenly caducous pale brown pubescent. Twig 2.5–4 by 2–3 mm  $\varnothing$  apically, compressed, becoming smooth, glabrous; stipule scars to 1 mm thick, amplexicaul, pale cream,  $\pm$  horizontal, smooth, glabrous. Bud 12–18 by 4–6 mm, compressed, hastate, narrowly obtuse. Stipule to 5 by 1.3 cm, broadly hastate, obtuse, constricted at base. Leaves 17–35 by 10–14 cm, elliptic-oblong,  $\pm$  coriaceous; base obtuse or subcordate; acumen to 1.5 cm long; nerves 11–20 pairs, prominent beneath, well spaced, at 55°–65°; tertiary nerves distinct, well spaced, scalariform, at 90° to nerves; midrib prominent, rounded, beneath, broad and appanate above; petiole 1.5–3 cm long. Panicle to 17 cm long, terminal or axillary, ribbed and compressed when dry, shortly evenly persistently buff pubescent, singly branched; bracteoles to 1.2 by 0.5 cm, oblong, subacute. Flower bud to 8 by 5 mm, broadly or narrowly ellipsoid. Calyx lobes densely pale brown pubescent outside, glabrous within; lobes subequal, broadly elliptic to deltoid, obtuse to acuminate. Petals pale pink, broadly ovate, obtuse, densely pubescent on parts exposed in bud. Stamens 15, of 2 lengths, the inner 5 an anther's length longer than the outer 10; filaments broad, compressed, united in a tube round the ovary, tapering distally and filiform below the oblong anthers; appendage to connective c. 2  $\times$  length of anther, slender, glabrous.

*Ovary* ovoid, densely pubescent in the distal half; stylopodium and style glabrous, spindle shaped, as long as ovary. *Fruit calyx* glabrous; 3 longer lobes to 11 by 3 cm, coriaceous, oblong, obtuse, to 1.5 cm broad above the to 1.8 by 2.3 cm horizontally elliptic deeply saccate thickened base; 2 shorter lobes to 8 by 1.5 cm, similar at base, base obscured by larger lobes. *Nut* to 6 by 4 cm, obovoid, persistently evenly shortly pale buff pubescent; style remnant, small, short, acute.

Distr. *Malesia*: Borneo (widespread, but especially W. and Central Sarawak, Kapuas valley, Tidung and Berau).

Ecol. Locally abundant on clay-rich periodically flooded alluvium and river banks, uncommon on hillsides, below 600 m.

Uses. The principal source of the Bornean Illippe nut; sometimes planted.

Vern. *Tengkawang*, *t. jantong*, *t. guntjong*, *tukung* (West Borneo), *engkabang jantong* (Sarawak, Iban), *kawang*, *k. jantong* (Brun.), *abang* (Mur., Dusun, S. Borneo), *kékawang buah* (Berau), *mengkaling* (Tidung), *orai tolloi* (Muara Tewe).

Note. The form occurring in E. Sabah shares certain characters (stipule scars, length of petiole, smaller nut) of *S. pinanga* and suggests hybridisation.

**127. *Shorea praestans*** ASHTON, Gard. Bull. Sing. 22 (1967) 297, pl. 42; Man. Dipt. Brun. Suppl. (1968) 115, f. 14.

Small tree. All parts apparently glabrous. *Twigs* c. 5 by 3 mm towards the apices, stout, compressed, smooth; stipule scars slender but clearly evident, amplexicaul. *Bud* to 25 by 7 mm, falcate-lanceolate, compressed, acute. *Stipules* to 11 by 5 cm, very large, elliptic, subacute, not at first caducous. *Leaves* 24–35 by 11–18 cm, large,  $\pm$  broadly oblong, thickly coriaceous; base cordate; apex obtuse or shortly broadly acuminate; nerves 11–13 pairs, obscure above, prominent beneath, at 45°–70°, remotely sub-scalariform, slender but evident beneath; midrib appanate above, prominent beneath; *petiole* 4–6.5 cm long, stout, drying rugose. *Flowers* and *inflorescences* unknown. *Fruit* entirely glabrous. *Pedice*l to 5 mm long and  $\emptyset$ , stout. 3 longer *calyx lobes* to 15 by 3 cm, spatulate, obtuse, glabrous, tapering to c. 1.5 cm broad above the to 1.5 by 1.8 cm broadly elliptic saccate thickened base; 2 shorter lobes to 10.5 by 1.5 cm, spatulate, subacute, similar at base. *Nut* to 2 by 2 cm, ovoid, glabrous; style remnant to 4 mm long, filiform.

Distr. *Malesia*: Borneo (Central Sarawak).

Ecol. Rare, deep yellow sandy soils in Mixed Dipterocarp forest on coastal hills.

Note. Vicarious with *S. stenoptera*, of which it appears to be a segregate; specimens from the Saribas valley in particular approach an intermediate leaf-shape.

**128. *Shorea rotundifolia*** ASHTON, Gard. Bull. Sing. 22 (1967) 299, pl. 44; Man. Dipt. Brun. Suppl. (1968) 117, f. 14. — **Fig. 103 B–B2.**

Medium-sized tree. Young twig, petiole and stipule pruinose, otherwise glabrous. *Twig* c. 3 by 2 mm  $\emptyset$  apically, terete or slightly compressed, smooth; stipule scars amplexicaul, prominent. *Bud* to 20 by 8 mm, large, lanceolate, compressed. *Stipule* to 6 by 2 cm, lanceolate-falcate, obtuse, subpersistent. *Leaves* alternate, 9–21 by 8–14 cm, broadly ovate to suborbicular, coriaceous, lustrous; base obtuse to cordate; acumen to 1 cm long, cuspidate; nerves 9–11 pairs, curved, prominent beneath, at to 115° towards the base, 45° towards the apex; tertiary nerves remotely scalariform; midrib appanate above, prominent and terete beneath. *Petiole* 3–4 cm long, very long. *Panicle* to 15 cm long, terminal or axillary, lax, glabrous, compressed; regularly singly branched, branchlets to 2 cm long, bearing remote distichous flowers; *bracts* to 10 by 6 mm, elliptic-lanceolate, acute, glabrous, fugaceous; *bracteoles* to 8 by 4 mm, similar. *Flower bud* to 10 by 4 mm, fusiform. *Calyx* glabrous; lobes narrowly deltoid, subequal, subacute. *Petals* lanceolate, shortly pubescent on parts exposed in bud. *Stamens* 15, the 5 innermost slightly longest; filaments broad, connate, tapering abruptly beneath the ellipsoid anthers; appendages c. 3  $\times$  length of anther, aristate. *Ovary* ovoid, glabrous, surmounted by a spindle-shaped style and stylopodium. *Fruit* glabrous. *Pedice*l c. 6 mm long, 3 longer fruit calyx lobes c. 13 by 2.5 cm, spatulate, obtuse, c. 6 mm broad above the c. 15 by 18 mm somewhat saccate thickened base; shorter lobes to 8 by 0.7 cm, narrowly lanceolate, subacute, similar at base. *Nut* c. 2.5 by 1.08 cm, ovoid, glabrous; style remnant to 7 mm long.

Distr. *Malesia*: Borneo (Central Sarawak).

Ecol. Local on inland ridges at 300–500 m.

Notes. A local species apparently derived from *S. amplexicaulis* with which it occurs.

Occurring as small groups or scattered individuals, with some local differentiation even within its small range.

**129. *Shorea amplexicaulis*** ASHTON, Gard. Bull. Sing. 19 (1962) 273, pl. 10; Man. Dipt. Brun. (1964) 177, f. 18, 20, pl. 53 (bark); *ibid.* Suppl. (1968) 104; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 95, f. 11. — **Fig. 105.**

Medium-sized to large tree. All parts, including stipule (both surfaces), caducous or persistently pale buff to golden pubescent. *Twig* to 3 by 2 mm  $\emptyset$  apically, slightly compressed when young, slender, becoming terete, glabrous, smooth; stipule scars c. 0.5 mm thick, horizontal,  $\pm$  amplexicaul. *Bud* 10–15 by 3–5 mm, hastate, obtuse. *Stipule* to 25 by 8 mm, hastate, subacute, subpersistent. *Leaves* 11–21 by 5–8 cm, elliptic, coriaceous; base cuneate; acumen to 1 cm long; nerves 9–12 pairs, curved, at 50°–70°, prominent beneath; tertiary nerves distinct, remotely scalariform; midrib prominent and terete beneath,  $\pm$  appanate above; *petiole* 15–2.5 cm long. *Panicle* to 24 cm long, terminal or axillary, lax, slender, compressed; regularly singly branched, branchlets to 10 cm long, bearing to 11 distichous flowers; *bracts* to 13 by 8 mm, lanceolate, acute, glabrous, fugaceous;



v. Os



Fig. 105. *Shorea amplexicaulis* ASHTON. a. Habit, b. fruit, c. nut, with part of indumentum, all  $\times \frac{1}{2}$  (a SAN 22690, b-c S 6502).

*bracteoles* to 11 by 5 mm, oblong, obtuse, glabrescent or persistently puberulent outside, glabrous within, subpersistent. *Flower bud* to 10 by 3.5 mm, lanceolate, obtuse. *Calyx* densely shortly pale grey pubescent outside, glabrous within; lobes subequal, narrowly deltoid, obtuse, slightly expanded at base. *Petals* pale yellow, narrowly lanceolate, subacute, shortly pubescent on parts exposed in bud. *Stamens* 15, the 5 inner slightly longest; filaments broad, united in a ring,

tapering abruptly beneath the narrowly oblong anthers; appendage to connective over twice as long as anther, not reflexed. *Ovary* ovoid, somewhat longer than ovary; no distinct stylopodium. *Fruit* impressed at base. *Calyx* puberulent or glabrescent; 3 longer lobes to 18 by 3 cm, oblong-spatulate, obtuse, to 2 cm broad above the to 1.6 by 2.2 cm broadly ovate saccate thickened base; 2 shorter lobes to 13 by 0.8 cm, similar at base. *Nut* to 3.7 by 2.5 cm, broadly ovoid, persistently evenly densely gold-buff pubescent; style remnant short, acute.

Distr. *Malesia*: Borneo (S.W. excepted).

Ecol. Widespread, often common, on clay soils, especially ridges, from sea level to 700 m.

Vern. *Kawang pinang*, *mēranti kawang pinang lichen* (Brun.), *langgai* (Iban), *abang* (Dus.), *kawang bukit* (Sabah), *orai lanyung*, *awang rambut* (S.E. Borneo), *ēngkabang pipit*, *tēngkawang megeh tēlur* (W. Borneo).

Notes. Sometimes difficult to distinguish from *S. beccariana*, especially when young; the amplexicaul stipule scars and crimson young parts are typical of the present species, and the golden-yellow stellate-hairy young parts and leaf undersurface of *S. beccariana* typically distinguish them.

In S.E. Borneo apparently hybridizing with *S. pinanga*, in W. Borneo with *S. pilosa* (q.v.).

**130. *Shorea mecistopteryx* RIDL.** Kew Bull. (1925) 280; SLOOT. in Merr. Pl. Elm. Born. (1929) 203; SYM. Gard. Bull. S. S. 9 (1938) 348; ASHTON, Man. Dipt. Brun. (1964) 198, f. 18, pl. 52 (bark), *ibid.* Suppl. (1968) 111; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 119, f. 2a, pl. 7 (habit). — *S. chrysophylla* RIDL. Kew Bull. (1926) 470; SLOOT. in Merr. Pl. Elm. Born. (1929) 202.

Large tree. Young twig, panicle, leaf bud, stipule outside, petiole and leaf beneath shortly evenly  $\pm$  persistently gold-tomentose. *Twig* to 6 by 2.5 mm  $\varnothing$  apically, compressed, becoming terete, smooth; stipule scars initially to 2.5 mm long, cuneate, horizontal. *Leaf bud* 5–8 by 2.5–5 mm, ovoid, compressed, obtuse. *Stipule* to 25 by 7 mm, hastate, acute. *Leaves* 13–20(–30) by 6–10(–12) cm, oblong, chartaceous; base cordate; acumen to 8 mm long, broad; nerves 16–20 pairs, curved, at 45°–65° along midrib and to 120° at base; tertiary nerves densely scalariform, at 90° to nerves; midrib prominent and terete beneath, rather narrow,  $\pm$  applanate above; *petiole* 2.5–3.5 cm long. *Panicle* to 12 cm long, terete or compressed, terminal or axillary, singly branched; *bracteoles* to 7 by 2 mm, oblong, subacute, densely pubescent outside, sparsely so within. *Flower bud* to 12 by 4 mm, lanceolate. *Calyx* densely shortly greyish pubescent outside, glabrous within; lobes narrowly deltoid, subequal,  $\pm$  patent, the 2 inner slightly shorter, thinner, slightly expanded at base. *Corolla* shortly pubescent on parts exposed in bud; *petals* linear, subacute. *Stamens* 15, the 5 inner somewhat longer than the others; filaments united in the basal half, tapering to the anthers in the distal half; anthers

oblong; appendage to connective over twice as long as anthers, not reflexed. *Ovary* narrowly ovoid-conical, glabrous; stylopodium somewhat longer than ovary, thickened in the distal half; style stout. *Fruit pedicel* to 6 mm long, stout. *Fruit calyx* glabrescent or persistently puberulent at base; 3 longer lobes to 23 by 3.3 cm, spatulate, narrowly obtuse, to 1.8 cm broad above the to 2 by 2.5 cm broadly ovate saccate thickened base; 2 shorter lobes to 15 by 1.2 cm, linear, similar at base, base enveloped by larger lobes. *Nut* to 4.2 by 2.5 cm, ovoid, persistently shortly evenly yellowish buff pubescent; style remnant acute.

Distr. *Malesia*: Borneo.

Ecol. Local: undulating land and low hills on sandy clay soils in Mixed Dipterocarp forest below 400 m.

Vern. *Těngkawang layar* (Kapuas), *těntang pakar* (M. Tewe), *ěngkabang larai* (Sarawak), *rěbah* (Iban), *kawang tikus*, *kawang burong* (Sabah).

Note. The most uniform and distinct species in the section.

**131. *Shorea beccariana*** BURCK, Ann. Jard. Bot. Btzg 6 (1887) 213; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 87; MERR. En. Born. (1921) 404; BROWNE, For. Trees Sarawak & Brunei (1955) 138; ASHTON, Gard. Bull. Sing. 20 (1963) 280; Man. Dipt. Brun. (1964) 180, f. 18, 20; *ibid.* Suppl. (1968) 105; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 100. — *S. franchetiana* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 956; Mem. Ass. Franç. Besançon 1892 (1893) 459. — *S. beccarii* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 87, *nomen in syn.* — **Fig. 104 C–C3.**

Medium-sized or large tree. Young twig, panicle, leaf bud, stipule (both surfaces), and petiole shortly evenly densely deep rufous-brown puberulent, becoming pale mauve-grey, sparsely so on nervation beneath and midrib above. *Twig* 3–6 by 1–2.5 mm  $\varnothing$  apically, compressed, becoming smooth, glabrous; stipule scars to 2 mm long, shortly cuneate or falcate,  $\pm$  ascending, sometimes horizontal, prominent. *Bud* 7–11 by 3.5–4.5 mm, hastate, compressed, acute. *Stipule* to 14 by 5 mm, small, oblong, obtuse, fugaceous. *Leaves* 11–20 by 5.5–7 cm, elliptic to ovate; coriaceous, gold lepidote beneath, becoming mauve-grey in mature trees; base obtuse or broadly cuneate; acumen to 8 mm long, broad; nerves 11–14 pairs, curved, not strongly raised beneath, at 50°–60°, to 90° at base; tertiary nerves remotely scalariform, slightly diagonal to nerves; midrib prominent beneath,  $\pm$  depressed above; *petiole* 2–4 cm long. *Panicle* to 20 cm long, terminal or axillary, lax,  $\pm$  compressed; singly branched, branchlets to 2.5 cm long, short, bearing to 8 distichous flowers; *bracts* to 15 by 9 mm, oblong, obtuse, shortly pubescent outside, puberulent within, fugaceous; *bracteoles* to 13 by 8 mm, otherwise as with bracts, caducous. *Flower bud* to 9 by 3 mm, lanceolate, obtuse. *Calyx* outside shortly pubescent or glabrescent, glabrous within; lobes subequal, deltoid, the inner 2 slightly shorter, thinner, somewhat expanded at base. *Petals* pink, paler along margins, lanceolate, obtuse, sparsely pubescent on parts exposed in bud.

*Stamens* 15, the inner 5 slightly longer; filaments broad, tapering in the distal half, united in a ring at the base; anthers oblong; appendage to connective 2–3  $\times$  length of anther, reaching almost to style apex. *Ovary* ovoid, frequently sparsely pubescent apically; style and stylopodium cylindrical,  $1\frac{1}{2}$ –2  $\times$  length of ovary, rather short, glabrous. *Fruit* base frequently impressed. *Calyx* glabrescent, sparsely dotted with minute hair tufts; 3 longer lobes to 19 by 2.7 cm, spatulate, obtuse, to 1.2 cm broad above the to 1.2 by 1.8 cm broadly ovate deeply saccate thickened base; 2 shorter lobes to 10.5 by 0.9 cm, subequal, linear, similar at base. *Nut* to 4 by 2.8 cm, broadly ovoid, shortly persistently evenly pale buff tomentose; style remnant to 4 mm long, conical.

Distr. *Malesia*: Northern Borneo (Ulu Kapuas, Sarawak to Sabah and Nunukan).

Ecol. Common on deep leached soils in lowlands and along dry sandstone and shale ridges to 1350 m.

Vern. *Měrantı langgai*, *kawang* (Brun.), *langgai* (Iban), *abang* (Dus.), *sěraya langgai* (Sabah), *těngkawang těngkal*, *t. raraing*, *t. bagok*, *t. layar*, *t. bėnuu*, *t. tangga*, *ěngkabang maha* (W. Borneo).

Note. Closely allied to *S. amplexicaulis*.

**132. *Shorea pinanga*** SCHEFF. Nat. Tijd. N. I. 31 (1870) 350; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 211, t. 24, 30, f. 1; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 94, t. 2, f. 17–18; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 267; BECC. For. Born. (1902) 570; Bull. Ort. Bot. Napoli 2 (1904) 92; MERR. En. Born. (1921) 406; SLOOT, in Merr. Pl. Elm. Born. (1929) 203; BACKER & BAKH. f. Fl. Java 1 (1963) 331; ASHTON, Gard. Bull. Sing. 20 (1963) 281; Man. Dipt. Brun. (1964) 210, f. 18, 20; *ibid.* Suppl. (1968) 115; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 137, pl. 9. — *S. gysbertsiana* BURCK var. *scabra* BURCK, Med. Lands Pl. Tuin 3 (1886) 17, p.p. — *S. compressa* BURCK, Med. Lands Pl. Tuin 3 (1886) 26; Ann. Jard. Bot. Btzg 6 (1887) 212; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 87; MERR. En. Born. (1921) 404. — **Fig. 103 A–A2.**

Medium-sized or large tree. Young twig, panicle, leaf bud, stipule and petiole shortly densely fugaceous to persistently gold-brown pubescent; sparsely so on leaf beneath. *Twig* 4–6 by 2–3 mm  $\varnothing$  apically, compressed, becoming smooth; stipule scars to 3 mm long, to 1.5 mm thick at base, strongly falcate, descending. *Bud* to 10 by 4 mm, hastate, subacute, usually hidden by stipules. *Stipule* to 6 by 1.5 cm, glabrescent, hastate, subacute, somewhat persistent. *Leaves* 11–24 by 4–9 cm, elliptic to narrowly ovate,  $\pm$  thinly coriaceous, with broadly cuneate to subcordate base and to 1.5 cm long deltoid acumen; nerves 10–20 pairs, slender, curved, at 50°–70° but to 90° at base; tertiary nerves densely scalariform, diagonal to nerves; midrib prominent and terete beneath,  $\pm$  applanate and narrow above; *petiole* 1.5–2.3 cm long, slender. *Panicle* to 24 cm long, terminal or axillary, lax, compressed; singly branched, the branchlets long, bearing to 15 distichous flowers; *bracts* to 15 by 7 mm, lanceolate, acute, glabrous to pubescent, fugaceous;



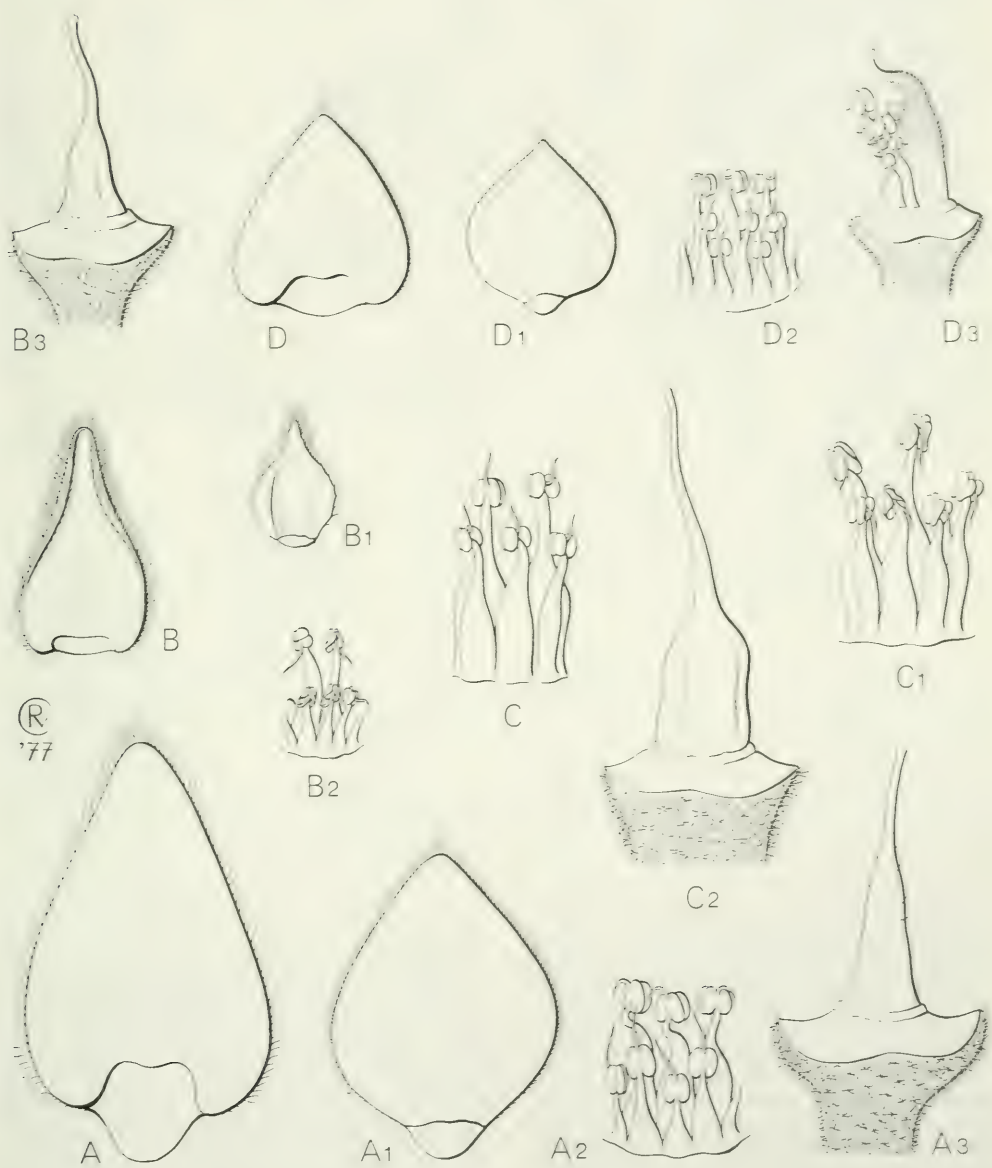


Fig. 106. Flower details in *Shorea* sect. *Mutica* BRANDIS. All  $\times 10$ . Sepals drawn from inside. — *S. slootenii* WOOD ex ASHTON. A. Outer sepal, A1. inner sepal. A2. stamens from outside. A3. pistil. — *S. platycarpa* HEIM. B. Outer sepal, B1. inner sepal, B2. stamens from outside. B3. pistil. — *S. macrantha* BRANDIS. C. Young stamens from outside. C1. older stamens from outside. C2. pistil. — *S. macroptera* DYER. D. Outer sepal, D1. inner sepal. D2. stamens from outside. D3. pistil (A ROSLI & ASAH 3365, B Neth. Ind. For. Serv. I-E-2P-694, C HAVILAND 2119, D SAN 36703 = NT 592).

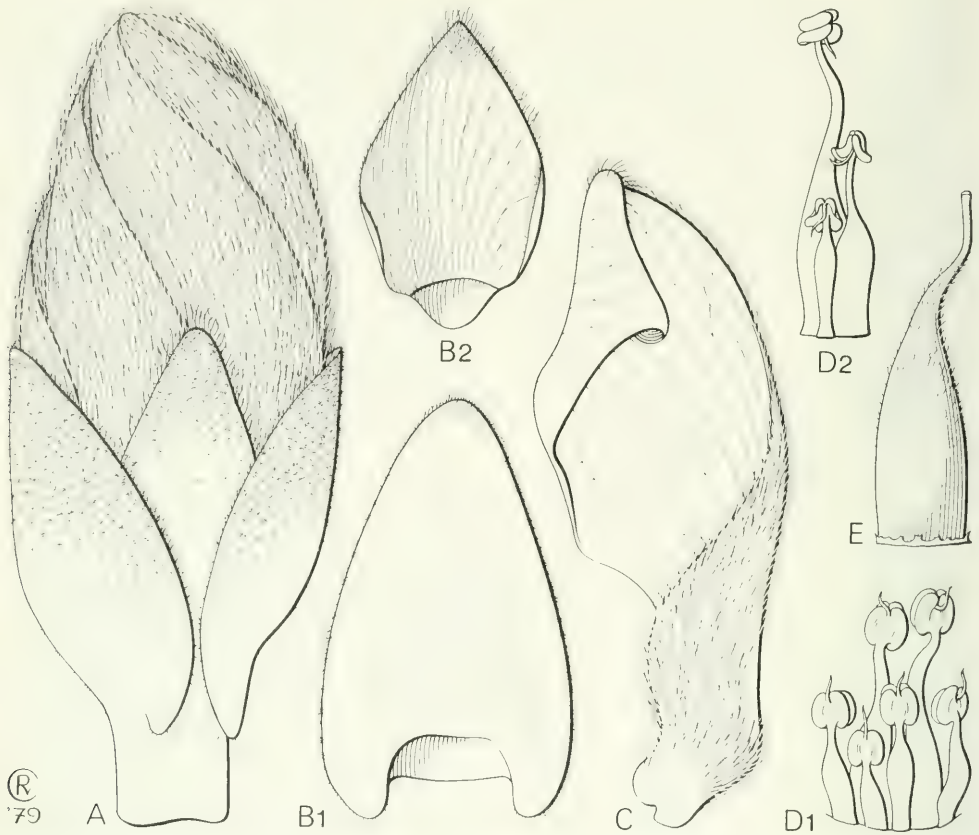


Fig. 107. Flower details in *Shorea* sect. *Mutica* BRANDIS subsect. *Auriculatae* ASHTON. — *S. myrionerva* SYM. ex ASHTON. A. Bud, B1. outer sepal, B2. inner sepal, C. petal, D1. stamens from a young bud, D2. stamens from mature bud, E. pistil, all  $\times 10$  (JACOBS 5371).

*bracteoles* to 10 by 8 mm, broadly ovate, acute, glabrous to pubescent, subpersistent. *Flower bud* to 10 by 3 mm, linear, subacute. *Calyx* glabrous or pubescent outside; lobes subequal, linear, subacute. *Petals* deep pink, hardly contorted, long, linear-lanceolate, sparsely pubescent on parts exposed in bud. *Stamens* 15, the innermost 5 slightly the longest; filaments broad, united in a ring round the ovary, tapering abruptly distally; appendage to connective many times length of anther, reaching to style apex. *Ovary* subglobose, surmounted by a long narrow style and stylopodium about twice its length, the latter 2 distended in the distal half; entirely glabrous. *Fruit calyx* glabrescent; 3 longer lobes to 28 by 3.5 cm, coriaceous, narrowly spatulate, narrowly obtuse, to 2.3 cm broad above the to 1.5 by 2.5 cm broadly ovate saccate thickened base; 2 shorter lobes to 17 by 1.2 cm, subequal, linear, similar at base. *Nut* to 2.3 cm long and broad, broadly ovoid, shortly evenly pale yellow-

ish buff pubescent; style remnant to 2 mm long, slender, acute.

*Distr. Malesia:* Borneo.

*Ecol.* Clay-rich soils especially on ridges below 700 m; locally common.

*Vern.* *Langgai* (Iban), *mĕranti langgai bukit* (Brunei), *kawang pinang* (Sabah), *awang lanying*, *a. kĕlalai*, *a. boi*, *a. labuan*, *abang burong*, *kakan mĕrah* (S.E. Borneo), *ĕngkabong bukit*, *tĕngkawang amung*, *t. tĕlur*, *t. kĕrayung*, *t. gunong*, *t. sambai*, *t. bunga*, *t. minggi*, *t. rĕput*, *t. lumut*, *t. umba*, *t. tĕlaga*, etc. (W. Borneo).

*Notes.* This, and to a lesser extent the two previous species, varies greatly and almost continuously in tomentum density, and also in leaf shape, number of nerves and relative length of petiole; the twig shape, and stipule scars are the most reliable characters to distinguish them.

The species may hybridize with *S. macrophylla* and *S. amplexicaulis* in restricted parts of its range.



## 9. Section Mutica

BRANDIS, J. Linn. Soc. Bot. 31 (1895) 100; ASHTON, Gard. Bull. Sing. 20 (1963) 268; Man. Dipt. Brun. (1964) 117. — *Shorea*, Red Meranti group, *S. parvifolia* subgroup, SYM. Mal. For. Rec. 16 (1943) 59, f. 36 (map). **Fig. 106, 107.**

*Flower buds*  $\pm$  ovoid. *Corolla* as in sect. *Rubella*. *Stamens* 15, in 3 verticils; filaments broad at base, tapering gradually to anthers; anthers with 4 pollen sacs, broadly oblong to subglobose; appendage to connective aristate, rather short, becoming reflexed at least on outer anthers. *Ovary* with distinct stylopodium, both  $\pm$  densely tomentose; style shorter than ovary or very slightly longer. Branchlets of *raceme* short; flowers dense. *Stipules*, *bracts* and *bracteoles* usually caducous, rarely subpersistent (*S. quadrinervis*, *S. acuminata*). *Leaf* with scalariform tertiary nerves; midrib  $\pm$  evident above. *Bark surface* usually becoming V-section fissured. *Wood* as in sect. *Brachypterae*.

Distr. Peninsular Thailand and Malesia: Malaya, Sumatra, Banka, Borneo.

Ecol. Scattered in lowland evergreen forest below 1600 m.

Vern. Red mēranti, mēranti mērah (Mal., Sum.), pērawan, lop (Iban).

## 9a. Subsection Auriculatae

ASHTON, Gard. Bull. Sing. 22 (1967) 300. — **Fig. 107.**

*Fruit calyx lobes* auriculate at base. *Bark surface* remaining smooth or, after passing through an ephemeral shallowly V-section fissured stage, becoming flaky.

Distr. As section.

Note. This subsection consists of two very distinct species, *S. slootenii* and *S. myrionerva*, and those others which cluster round the geographically very variable *S. macroptera*. *S. macroptera* is known in Malaya to be thrip pollinated, and variably apomictic through adventive polyembryony (CHAN H. T.), all but *S. macroptera* are endemic to Borneo: *S. macroptera* itself manifests great morphological uniformity except in that island where it is highly variable.

**133. *Shorea slootenii*** WOOD ex ASHTON, Gard. Bull. Sing. 19 (1962) 312, pl. 29; Man. Dipt. Brun. (1964) 222, f. 16; *ibid.* Suppl. (1968) 119; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 147. — **Fig. 106 A–A3.**

Twig, panicle, leaf bud, stipule outside (pubescent within), petiole and leaf beneath densely persistently scabrid pale fulvous tufted tomentose, the tufts short, hard and knob-like; midrib above shortly pubescent. *Twig* to 5 by 3  $\varnothing$  apically, stout, compressed and ribbed at first, later terete, verrucose owing to the persistent bases of the hair-tufts; stipule scars to 3 mm long, 0.5 mm thick at base at first, long cuneate, slightly ascending. *Bud* 6–10 by 5–8 mm, broadly ovoid, slightly compressed, obtuse. *Stipule* to 25 by 8 mm, oblong, obtuse. *Leaves* 11–22 by 4–7 cm, broadly oblong, coriaceous, deeply cupped; base obtuse; acumen to 1.5 cm long; nerves (25–)27–34 pairs, dense, depressed above, prominent beneath, arched at margin at 50°–60°; tertiary nerves scalariform, prominent beneath, slightly diagonal to nerves or at 90°; midrib prominently terete beneath, depressed above; *petiole* 1.7–2.3 cm long, stout. *Panicle* to 18 cm long,

terminal or axillary, stout, brittle,  $\pm$  compressed; singly or doubly regularly branched, branchlets short, bearing to 4 flowers; *bracteoles* to 3 by 2 mm, ovate to deltoid, obtuse, densely yellowish brown pubescent outside, glabrous within, caducous. *Flower bud* to 12 by 7 mm, ovoid to ellipsoid, obtuse. *Calyx* shortly densely tawny pubescent outside, glabrous within; 3 outer lobes ovate acuminate, longer than the 2 acute inner lobes. *Petals* pale yellow, lanceolate, subacute, densely shortly tawny pubescent on parts exposed in bud. *Stamens* 15, the 5 inner reaching the base of the style, about twice as long as the other 10, the latter of two different heights; filaments tapering gradually, slightly twisted in bud; anthers globose; appendage to connective shorter than anther, reflexed on 5 inner stamens; twice as long as anthers, hardly reflexed, on 10 outer stamens. *Ovary* and *stylopodium* narrowly ovoid to lanceolate, sparsely setose in distal half, surmounted by a broadly filiform style almost as long as the ovary, glabrous. *Fruit calyx* lustrous, puberulent, more densely so towards the base; 3 longer lobes to 17 by 1.8 cm, oblong, obtuse, hardly tapering towards base; base with an ovoid to 2 by 1.2 cm



Fig. 108. *Shorea myrionerva* SYM. ex ASHTON. a. Habit, b. fruit, c. seed, all  $\times \frac{1}{4}$  (a S 31986, with terminal bud from bb. 14614, b-c S 15591).

saccate thickened central area adpressed to nut, the lobes continuing laterally as to 1 cm broad auricles, tapering abruptly at pedicel; 2 shorter lobes 5.5 by 0.7 cm, unequal, linear, similarly expanded and auriculate at base. *Nut* to 3.5 by 1.3 cm, ovoid, densely shortly pale brown to buff pubescent; style remnant to 4 mm long, tapering, acute.

Distr. *Malesia*: N.W. Borneo (Lower Kapuas, Sarawak to S.W. Sabah).

Ecol. Local, sandy clay soils on hills near the present or Pleistocene coastline, to 400 m.

Vern. *Mēranti kèpong*, *m.k. kasar* (Sar., Brun.), *kawang raung* (Dusun).

**134. *Shorea myrionerva* SYM. ex ASHTON**, Gard. Bull. Sing. 19 (1962) 299, pl. 23; Man. Dipt. Brun. (1964) 201, f. 16; *ibid.* Suppl. (1968) 111; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 122. — *Shorea* sp. BROWNE, For. Trees Sarawak & Brunei (1955) 145. — **Fig. 107-109.**

Medium-sized, occasionally large, tree. Twig and petiole persistently dotted with scattered pale fulvous-

brown long hair tufts; nervation beneath and stipule more shortly so; fully expanded leaf glabrescent. *Twig* 2.5–3.5 mm  $\varnothing$  apically, stout, straight, little branched, terete; stipule scars to 2 mm long, to 1 mm wide, pale, cuneate. *Bud* to 10 by 7 mm, a loose group of bud-scales, compressed. *Stipule* to 17 by 7 mm, broadly hastate, subauriculate, subacute, subpersistent (more so in young trees and saplings). *Leaves* 12–22 by 4.5–9 cm, narrowly oblong, chartaceous; base obtuse; apex tapering abruptly; acumen to 8 mm long, broad; nerves 24–28 slender close pairs, prominent beneath, curved towards the margin; tertiary nerves slender, scalariform, at c. 90°; midrib depressed above; *petiole* 1.2–2 cm long, short, stout. *Panicle* to 8 cm long, axillary, rarely terminal, becoming ramiflorous, terete, ribbed on drying, lax, glabrous but for sparse fulvous tufts towards base; singly branched, the branches short, bearing to 5 distichous flowers; *bracts* to 8 by 1.5 mm, narrowly lanceolate, acute, puberulent outside, glabrous within; *bracteoles* to 5 by 3 mm, ovate, obtuse. *Flower bud* to 5 by 3 mm, elliptic, obtuse. *Calyx* shortly densely pubescent outside,



glabrous within; lobes subequal, ovate, the outer 3 rather narrower and subacuminate. *Petals* dark red with a pale margin, narrowly ovate, obtuse, densely yellowish gold pubescent on parts exposed in bud. *Stamens* 15, of 3 lengths, the inner 5 much longer than the others and almost reaching the style apex; filaments thick, tapering gradually; anthers broadly oblong, slightly tapering; appendages to connective short, becoming reflexed. *Ovary* and *stylopodium* narrowly conical to pyriform, shortly pubescent; style somewhat shorter than ovary and stylopodium, broadly filiform, glabrous. *Fruit calyx* glabrous; 3 longer lobes to 17 by 2.5 cm, oblong, obtuse, thinly chartaceous, not tapering basally; base thickened and saccate at the centre, with 2 thin, to 1.5 cm broad, lateral auricles; 2 shorter lobes subequal, to 8 by 0.7 cm, linear, saccate but not auriculate. *Nut* to 2.5 by 1.3 cm, ellipsoid, pruinose, glabrous; style remnant c. 1.5 mm long, acute.

Distr. Malesia: Borneo (Rejang hinterland to S.W. Sabah, E. Kutei).

Ecol. On moist clay hillsides, alluvium and riverbanks.

Vern. *Abang gunung* (Kutei), *kawang tikus* (Brunei), *sĕraya urat*, *banyak* (Sabah), *pitun* (Dus.), *abang* (Murut), *langgai*, *sĕpit undang*, *ĕngkabang* (Iban).

**135. *Shorea sagittata* ASHTON**, Gard. Bull. Sing. 22 (1967) 299, pl. 45, 352 (phot. habit); Man. Dipt. Brun. Suppl. (1968) 118, f. 15, pl. 23 (stem-base).

Large tree. Leaf above evenly caducous cream-buff pubescent, other vegetative parts densely shortly persistently pink-brown scabrid tomentose. *Twig* c. 2 mm  $\varnothing$  at first, terete, ribbed, becoming red-brown verruculose; stipule scars short, ascending. *Bud* to 7 by 7 mm, broadly ovoid. *Stipule* to 10 by 8 mm, ovate, subacute, saccate, caducous. *Leaves* 7–15 by 3–6 cm, narrowly oblong to lanceolate; base obtuse; acumen to 1.5 cm long, slender; nerves 19–25 pairs, slender but prominent beneath, at 70°–80° near the base, 50° near the apex; tertiary nerves slender, densely scalariform; midrib depressed above, prominent beneath; petiole 9–17 mm long. *Panicle* imperfectly known, at least 6 cm long, singly branched, densely persistently pink-brown scabrid tomentose. *Fruit calyx* sparsely puberulent; 3 longer lobes to 11 by 2.5 cm, lorate-spatulate, obtuse, tapering only slightly above the prominently sagittate-auriculate base, base in all to 18 mm broad, with to 6 by 4 mm elliptic thickened saccate central disc; 2 shorter lobes to 2 cm long, c. 3 mm wide, linear, acute, not auriculate at base. *Nut* 15 by 8 mm, ellipsoid, shortly apiculate, puberulent towards the apex.

Distr. Malesia: N.W. Borneo (Central and W. Sarawak, Ulu Kapuas in W. Borneo; ?Tidung, ?Puraktjau, sterile collections).

Ecol. Locally frequent on sandy clay soils on low hills and ridges to 1000 m, in Mixed Dipterocarp forest.

Vern. *Mĕranti luang* (Sarawak).

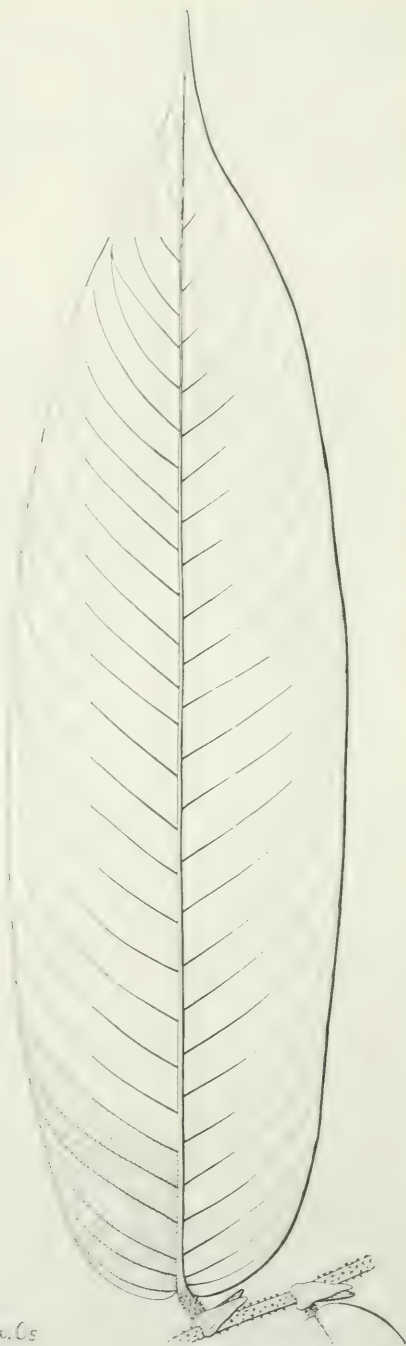


Fig. 109. *Shorea myrionerva* SYM. ex ASHTON. Part of twig and leaf of 3 m high sapling,  $\times \frac{1}{2}$  (BRUN 5200).

136. *Shorea macroptera* DYER, Fl. Br. Ind. 1 (1874) 308; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 90; BRANDIS & GILG in E. & P. Fl. Fam. ed. 1, 3, 6 (1895) 267. — Fig. 106 D-D3.

Note. Beside the subspecies described at least two forms (one in Melawi, one in S. Central Kalimantan) exist in Indonesian Borneo, for which more complete material is required. See also under the next species, *S. ferruginea*.

#### KEY TO THE SUBSPECIES

1. Panicles singly branched or doubly branched at base.
  2. Twigs, petioles and panicles densely evenly shortly buff pubescent . . . **a. ssp. macroptera**
  2. Twigs, petioles and panicles sparsely tufted tomentose or glabrescent . . . **b. ssp. baillonii**
1. Panicles doubly branched; tomentum dense, even, persistent.
  3. Leaves (9-)18-23 by (4-)6.5-9.5 cm; nerves 13-15 pairs . . . **c. ssp. sandakanensis**
  3. Leaves 8-16 by 4-6 cm; nerves 10-14 pairs . . . **d. ssp. macropterifolia**

**a. ssp. macroptera.** — KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 113; RIDL, Agr. Bull. Str. & F.M.S. 1 (1901) 57; Fl. Mal. Pen. 1 (1922) 225; BURK, J. Str. Br. R. As. Soc. 76 (1917) 164, fig.; *ibid.* 81 (1920) 51, 70, 75, fig.; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 305; *ibid.* ed. 2 (1927) 1123; FOXW. Mal. For. Rec. 3 (1927) 30; *ibid.* 8 (1930) 21; *ibid.* 10 (1932) 195; EDWARDS, Mal. For. Rec. 9 (1932) 145; BURK, Dict. (1935) 2016; SYM. Mal. For. Rec. 16 (1943) 78, f. 38, 48; ASHTON, Gard. Bull. Sing. 20 (1963) 276. — *S. auriculata* SCORT. ex FOXW. Mal. For. Rec. 10 (1932) 195, *nom. in syn.*

Large tree. Young twig, panicle, leaf bud, stipule outside (puberulent within), petiole, midrib above at base and nervation beneath densely evenly shortly pale brown pubescent. Twig to 2 mm  $\varnothing$  apically, frequently slightly compressed, becoming terete, glabrous; stipule scars short, narrowly cuneate,  $\pm$  horizontal. Bud 4-6 by 2.5-4 mm, ovoid, subacute. Stipules to 8 by 3 mm, oblong, subacute, fugaceous. Leaves 10-15 by 3-5 cm, elliptic or oblong, coriaceous; base broadly cuneate; acumen to 1 cm long; nerves 12-15(-18) pairs, prominent beneath, curved, at 40°-50°; tertiary nerves slender, densely scalariform, sinuate, diagonal to nerves; midrib prominent and terete beneath, slightly depressed above; petiole 1.5 cm long. Panicle to 10 cm long, terminal or axillary, slightly compressed or terete, lax; singly branched or doubly branched near base, the branchlets bearing to 7 distichous flowers; bracteoles to 3.5 by 2.5 mm, elliptic, obtuse, shortly yellowish brown pubescent outside, glabrous within, fugaceous. Flower bud to 5 by 3 mm, ovoid. Calyx outside densely shortly pale yellowish brown pubescent, glabrescent within; lobes subequal, ovate, the 3 outer acuminate, the 2 inner acute. Petals cream to pink at base, linear, acute, twisted, yellow pubescent on parts exposed in bud.

Stamens 15, of 3 lengths, the longest reaching just above the ovary; filaments tapering gradually; anthers broadly oblong; appendage to connective short, becoming reflexed. Ovary and stylopodium  $\pm$  conical, densely pale grey pubescent, glabrous near base; style c. 1/2 length of ovary, slender, glabrous. Fruit calyx shortly sparsely puberulent, glabrescent; 3 longer lobes to 12 by 2.3 cm, spatulate, obtuse, to 1 cm broad above base; base with to 7 by 5 mm ovoid saccate thickened centre and 2 lateral narrow auricles, the whole to 1.2 cm broad, abruptly tapering at pedicel; 2 shorter lobes to 6 by 0.6 cm, narrowly oblong, similar at base. Nut to 1.8 by 1.2 cm, ovoid, densely evenly shortly pale buff pubescent; style remnant 2 mm long, acute.

Distr. Peninsular Thailand, and *Malesia*: Malaya (excepting seasonal areas), Singapore, Singkep, Lingga, E. Sumatra (Djambi, Indragiri, Kuantan Distr., Langkat).

Ecol. Well drained Mixed Dipterocarp forest, especially in hills, to 900 m, common.

Vern. *Mēlanta*, *mēranti mēlantai*, *m. bēlantai*, *m. kunyit*, *m. kētapah*, *kēpong labu*, *k. sēgar*, *tēmak* (Malaya), *lukup* (Riouw), *mēranti undang*, *m. sabut*, *m. piring*, *m. tēlor*, *m. mangu*, *m. tampalu*, *m. kunyit* (Sumatra).

**b. ssp. baillonii** (HEIM) ASHTON, Gard. Bull. Sing. 20 (1963) 277, f. 16, pl. 51 (bark); Man. Dipt. Brun. Suppl. (1968) 111; BROWNE, For. Trees Sarawak & Brunei (1955) 137. — *S. bailloni* HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 973.

Defining characters: Small tree. Twigs, petioles and panicle sparsely tufted pubescent or glabrescent, drying blackish. Leaves 12-19 by 3.5-7 cm, narrowly elliptic; base narrowly cuneate; apex tapering; nerves 11-14(-15) pairs, prominent but terete beneath. Panicles c. 13 cm long, singly branched or doubly so at base; branchlets to 2.5 cm long. 3 longer fruit calyx lobes to 13 cm long.

Distr. *Malesia*: W. Borneo (Sampit, Lower Kapuas, Sarawak west of Bintulu).

Ecol. Clay soils on low hills to 600 m, common.

Vern. *Mēranti mēlantai* (Sar.), *sēpit undang* (Iban).

**c. ssp. sandakanensis** (SYM.) ASHTON, Gard. Bull. Sing. 20 (1963) 277. — *S. macroptera* SLOOT. in Merr. Pl. Elm. Born. (1929) 203; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 116, f. 14, p.p. — *S. sandakanensis* SYM. Gard. Bull. S. S. 9 (1938) 343, pl. 25.

Defining characters: Large tree. Leaves (9-)18-23 by (4-)6.5-9.5 cm, narrowly oblong; base obtuse; apex abruptly attenuate; nerves 13-15 pairs, prominently acute beneath; petiole to 2 cm long. Panicles to 16 cm long, doubly branched, branchlets to 8 cm long. 3 longer fruit calyx lobes to 14 cm long.

Distr. *Malesia*: E. Borneo (Kudat to Balikpapan; wrongly recorded from Sarawak by BROWNE, For. Trees Sarawak & Brunei p. 143).

Ecol. As *ssp. baillonii*.



Vern. *Sēraya mēlantai* (Sabah), *tēgērangān sibū*, *t. batu* (Nunukan).

**d. ssp. *macropterifolia*** ASHTON, Gard. Bull. Sing. 20 (1963) 277; Man. Dipt. Brun. (1964) 197; *ibid.* Suppl. (1968) 111; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 116.

Defining characters: Large tree. *Leaves* 8–16 by 4–6 cm, narrowly ovate, coriaceous; base obtuse; apex tapering; nerves 10–14 pairs, slender but sharply prominent beneath; petiole to 1.5 cm long. *Panicles* to 16 cm long, twice branched; branchlets to 8 cm long. 3 longer *fruit calyx lobes* to 14 cm long.

Distr. *Malesia*: northern Borneo (Rejang hinterland to W. Sabah).

Ecol. Clay soils on undulating land and hillsides to 600 m, local.

Vern. *Mēranti mēlantai* (Brun.), *sēpitundang* (Iban).

**137. *Shorea ferruginea*** DYER *ex* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 91; BECC. For. Born. (1902) 570; MERR. En. Born. (1921) 405; BROWNE, For. Trees Sarawak & Brunei (1955) 139; ASHTON, Gard. Bull. Sing. 20 (1963) 281; Man. Dipt. Brun. (1964) 187, f. 19; *ibid.* Suppl. (1968) 108; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 106. — *S. discolor* HEIM, Rech. Dipt. (1892) 67, *nomen*.

Large tree. Young twig, panicle, leaf bud, stipule outside (glabrescent or shortly pubescent within), petiole beneath and leaf above sparsely persistently pale brown scabrid puberulent. *Twig* 2–2.5 mm  $\varnothing$  apically, terete, ribbed below the stipule scars, becoming smooth; stipule scar c. 2 mm long, c. 0.5 mm thick, pale, cuneate, slightly falcate, horizontal or slightly ascending. *Leaf bud* 5–8 by 4–6 mm, ovoid, subacute. *Stipule* to 15 by 5 mm, hastate, acute. *Leaves* 12–24 by 5.5–11 cm, broadly oblong to ovate, thinly coriaceous; base obtuse; acuminate to 1.2 cm long; nerves 15–19 pairs, prominent, at 60°–70°, curved apically; short secondary nerves frequently present; tertiary nerves elevated, remote, at 90° to nerves; midrib prominent and terete beneath, depressed above; *petiole* 1–1.5 cm long, short. *Panicle* to 22 cm long, terminal or axillary, terete or ribbed, lax, regularly alternately singly or doubly branched, the branchlets bearing to 7 secund flowers; *bracts* and *bracteoles* to 7 by 3 mm, ovate, acute. *Calyx* shortly densely pale grey-brown pubescent, glabrous within; 3 outer lobes longer,  $\pm$  deltoid to ovate, subacute; 2 inner lobes shorter, narrowly deltoid to ovate, acute, acuminate. *Petals* narrowly oblong, densely pubescent on parts exposed in bud. *Stamens* 15, the 5 inner anther's length longer than the others; filaments basally expanded, abruptly tapering and filiform distally; anthers oblong; appendage to connective reaching to style apex on 5 inner stamens, more than twice as long as anthers, curved but not reflexed. *Ovary* and *stylopodium* pyriform, densely pubescent in the distal half, shortly densely pubescent basally, style as long as ovary and stylopodium, filiform, glabrous. *Fruit* subsessile. *Calyx* glabrescent; 3 longer lobes to 5 by 0.8 cm, spatulate,



Fig. 110. *Shorea acuta* ASHTON. a. Tip of sterile twig, b. fruit, c. nut, all  $\times \frac{1}{2}$  (a SAN 17474, b–c BRUN 3291).

subequal, to 3.5 mm broad above the to 1.5 by 1.2 cm ovate glabrous shallowly saccate thickened base; 2 shorter lobes to 23 by 1.5 mm, linear, similar at base. *Nut* to 2.7 by 1.0 cm, ovoid, shortly buff pubescent, apiculate, shorter than longer calyx lobes.

Distr. *Malesia*: Borneo.

Ecol. Widespread on skeletal soils along ridges to 1100 m.

Vern. *Seraya melantai kechil* (Sabah), *meranti menalit* (Sar.), *tehan betung*, *t. paru*, *t. parei*, *t. lutup*, *lampong tahan* (S.E. Borneo).

Note. Collections from Melawi which I ascribe to *S. macroptera* on account of their prominent nervation possess the indumentum of this species and underline the close relationship between the two. I maintain this species separately from *S. macroptera* because, throughout its range in East Malaysia I never saw morphologically intermediate individuals though the two species commonly grow in mixture.

**138. *Shorea acuta*** ASHTON, Gard. Bull. Sing. 19 (1962) 268, pl. 8; Man. Dipt. Brun. (1964) 174, f. 16; *ibid.* Suppl. (1968) 104. — Fig. 110.

Large tree. Young twig, panicle, leaf bud, stipule (both surfaces), petiole, nervation beneath and midrib above evenly persistently shortly pale brown puberulent, glabrescent on nervation and midrib. *Twig* to 4 mm  $\varnothing$ , slightly compressed at first, becoming terete, glabrous, smooth; stipule scars initially to 3 mm long, to 1 mm thick, cuneate, horizontal. *Bud* 6–10 by 4–6 mm, ovoid, subacute. *Stipule* to 12 by 5 mm, oblong, obtuse. *Leaves* 14–26 by 6.5–12 cm, elliptic, thickly coriaceous; base obtuse, sometimes broadly cuneate; acumen to 2 cm long,  $\pm$  narrowly deltoid; nerves 10–13 pairs, prominent beneath, curved, at 45°–55° along the midrib, to 90° at the base; tertiary nerves slender, sinuate, densely scalariform, diagonal to nerves; midrib prominent and terete beneath, narrowly slightly depressed above; *petiole* 1.5–2 cm long, stout. *Panicle* to 8 cm long, terminal or axillary, compressed; singly or doubly branched at 2 cm intervals, branchlets to 6 cm long, bearing to 9 distichous flowers; *bracteoles* to 3.5 by 2.5 mm, elliptic, obtuse, shortly yellowish brown puberulent outside, glabrous within, caducous. *Flower bud* to 9 by 4 mm, narrowly ellipsoid, obtuse. *Calyx* shortly densely yellowish buff pubescent outside, glabrous

within; lobes subequal, ovate, subacute. *Corolla* dark crimson, pubescent on parts exposed in bud; petals linear, subacute. *Stamens* 15, of 3 lengths, the longest reaching just above the ovary, filaments tapering gradually; anthers subglobose; appendage to connective short, becoming reflexed. *Ovary* and *stylopodium* narrowly conical to ovoid, long tomentose towards the apex, shortly so at base; style c.  $\frac{1}{3}$  length of ovary and stylopodium filiform, glabrous. *Fruit calyx* shortly sparsely glabrescent; 3 longer lobes to 15 by 2.8 cm, spatulate, obtuse, to 1.5 cm broad above the base; base to 18 mm broad, with to 8 by 7 mm ovate saccate thickened centre and 2 lateral auricles, abruptly tapering to the pedicel; 2 shorter lobes to 8 by 0.7 cm, linear, unequal, similar at base. *Nut* to 3 by 2 cm, ovoid, shortly evenly densely pale fulvous to buff pubescent; style remnant short, acute.

Distr. *Malesia*: Borneo (N.E. Sarawak, Brunei).

Ecol. Locally common below 400 m, on deep sandy soils in Mixed Dipterocarp forest.

Vern. *Mēlantai*, *kawang tikus*, *ēngkabang tikus*, *mēranti kawang tikus* (Brun.), *mērabubok*, *langgai* (Iban).

### 9b. Subsection *Mutica*

ASHTON, Gard. Bull. Sing. 22 (1967) 301 ('*Muticae*'). — *Shorea subg. Rubroshorea* MEIJER, Act. Bot. Neerl. 12 (1963) 322. — **Fig. 106.**

*Fruit calyx lobes* not auriculate. *Bark surface* early becoming deeply and persistently V-section fissured, only rotting off in very large trees.

Distr. As section.

Note. Species of this subsection are, with the exception of *S. scabrida* and *S. retusa* easy to identify. Many are widespread and morphologically remarkably uniform. *S. parvifolia*, which is usually variable for the subsection, and consists of at least two ecotypically and partially geographically separate forms is linked with several sibling species endemic in Borneo (*S. rubra*, *S. foraminifera*, *S. scabrida*, *S. retusa*, *S. revoluta*); it is known to be partially apomictic through adventive polyembryony (MAURY). Hybridization is known among some species but is exceptionally rare. All species are thrip pollinated, and sympatric species flower sequentially (CHAN, H. T.).

**139. *Shorea quadrinervis*** SLOOT. Bull. Bot. Gard. Btzig III, 17 (1942) 220, f. 21; BROWNE, For. Trees Sarawak & Brunei (1955) 142; ASHTON, Man. Dipt. Brun. (1964) 213, f. 16, pl. 56 (habit); *ibid.* Suppl. (1968) 116; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 140. — **Fig. 111.**

Medium-sized, occasionally large, tree. Young parts shortly densely tawny pubescent, largely caducous on stipule, leaf bud and leaf beneath; leaf above glabrous but for midrib. *Twig* c. 3 mm  $\varnothing$  at apex, terete, stout, strongly ridged below stipule scars, becoming minutely cracked longitudinally; stipule scars c. 3 mm long, c. 1 mm broad, pale, falcate or amplexicaul-descending. *Bud* to 2 by 1.3 cm, loosely enclosed by stipular bud scales, compressed, subcordate. *Stipule* to 2.5 by 1.3 cm, ovate to subcordate, subsistent, glabrescent, persistently ridged along the 5 nerves; stipule pairs sometimes united at base.

*Leaves* 10–18 by 5–8 cm, broadly ovate to elliptic, strongly cupped; margin usually slightly revolute; base obtuse; acumen to 1.3 cm long; nerves c. 4 pairs, strongly curved, at c. 40°–70° with 1 or more secondary nerves of varying length; tertiary nerves slender, scalariform, at c. 90° to nerves; midrib depressed above; *petiole* 8–10 mm long. *Panicle* to 28 cm long, terminal or axillary, large, spreading, lax, terete or angular, densely persistently pale rust pubescent; doubly, sometimes trebly branched, branchlets 1–8 cm long, straight, bearing to 6 secund flowers; *bracts* as the stipules,  $\pm$  caducous; *bracteoles* to 2 by 1 mm, ovate to elliptic, obtuse, densely grey pubescent outside, puberulent within. *Flower bud* to 4.5 by 5.5 mm, broadly elliptic to subglobose, obtuse. *Calyx* shortly pale grey pubescent outside, glabrous within; lobes  $\pm$  patent, subequal, ovate, the inner 2 slightly more acute. *Petals* pink, paler at margins, elliptic,





Fig. 111. Habit of *Shorea quadrinervis* SLOOT. with drooping branches. Brunei (Photogr. ASHTON, 1959).

obtuse, densely pubescent on parts exposed in bud. *Stamens* 15, the inner 5 longest, the outer 10 sometimes vestigial; filaments tapering gradually; anther subglobose; appendage to connective shorter than anther, becoming reflexed. *Ovary* and *stylopodium* conical, densely pubescent; style short, frequently expanded at the stigma. *Fruit calyx* shortly sparsely pubescent; 3 longer lobes to 8 by 1.3 cm, narrowly spatulate, obtuse, 2–3 mm broad above the *c.* 5 by 4 mm thickened base; 2 shorter lobes to 5.5 by 0.7 cm, unequal, tapering to *c.* 2 mm broad, base as in longer lobes. *Nut* to 1.5 by 0.7 cm, narrowly ovoid, shortly buff pubescent; style remnant *c.* 1.5 mm long, slender, acute.

Distr. *Malesia*: N.W. Borneo (Ulu Kapuas, Sarawak to W. Sabah).

Ecol. Common on sandy clay soil on low hills, occasionally to 700 m.

Vern. *Téngkolong*, *témpilong*, *měranti témpilong* (W. Borneo), *měranti sudu* (Sarawak), *sěraya sudu* (Sabah).

140. *Shorea acuminata* DYER, Fl. Br. Ind. 1 (1874) 305; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 113;

BRANDIS, J. Linn. Soc. Bot. 31 (1895) 91; RIDL, Agr. Bull. Str. & F.M.S. 1 (1901) 58; Fl. Mal. Pen. 1 (1922) 225; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 296; *ibid.* ed. 2 (1927) 1115; Foxw. Mal. For. Rec. 3 (1927) 32; *ibid.* 8 (1930) 23; *ibid.* 10 (1932) 197; EDWARDS, Mal. For. Rec. 9 (1931) 139; BURK, Dict. (1935) 2006; SYM, Mal. For. Rec. 16 (1943) 65, f. 38, 39; SLOOT, Bull. Bot. Gard. Btzg III, 18 (1949) 251, f. 11.

Large buttressed tree, to 50 m. Young parts densely buff pubescent, persistent on twig apices, midrib above, petioles, panicles, parts of perianth exposed in bud, ovary and calyx, caducous elsewhere; becoming sparse on fruit calyx and expanding stipules. *Twigs* *c.* 2 mm  $\varnothing$  apically, terete, smooth, pale brown; stipule scars prominent, horizontal. *Leaf buds* small, conical, acute, generally hidden in the conspicuous, to 30 by 8 mm, oblong cordate obtuse lustrous concave subpersistent stipules. *Leaves* 6–12 by 2.6–6 cm, ovate-falcate, coriaceous, lustrous beneath; base subequal, obtuse to broadly cuneate; margin subrevolute; acumen to 1.8 cm long, slender; nerves 7–11 pairs, arched, ascending, slender but  $\pm$  prominent beneath, frequently spaced irregularly along the midrib and with  $\pm$  prominent short secondary nerves; tertiary nerves scalariform, obscure; midrib slender but prominent, terete, beneath, evident above; *petiole* 7–9 mm long, short. *Panicles* to 12 cm long, terminal or axillary, singly (if axillary) or doubly branched; branchlets to 2 cm long, bearing to 6 congested second flowers; *bracts* as stipules, frequently subpersistent in terminal inflorescences. *Flower bud* to 4 by 2 mm, lanceolate; *sepals* broadly ovate, the 3 outer somewhat larger, acute, the 2 inner acuminate; *petals* dark wine red, paler towards base; *stamens* 15, in 3 unequal verticils; filaments loriate, tapering; anthers small, subglobose; appendages shorter than anthers, becoming reflexed on inner 2 verticils; *ovary* ovoid, tapering into a somewhat longer columnar tapering style. *Fruit pedicel* to 2 mm long, slender; 3 longer *calyx lobes* to 9 by 1.2 cm, narrowly spatulate, obtuse, *c.* 2 mm broad above the to 6 by 4 mm ovate thickened saccate base; 2 shorter lobes to 25 by 2 mm, linear, similar at base. *Nut* to 1.5 by 6 mm, lanceolate, prominently apiculate.

Distr. *Malesia*: Malaya (from Lower Perak and Trengganu R. southwards), Sumatra (Langsa and P. Musala south to northern Palembang), Lingga.

Ecol. Common in Mixed Dipterocarp forest, on undulating land and hills to 400 m.

Vern. *Měranti rambai daun*, *m. hijau* (Malaya), *damar tēkēk*, *m. samarupa*, *samarupa* (Achin), *latuko*, *měranti bunga*, *m. gombang* (Tapanuli), *měranti sarang burung*, *m. sarang punai*, *m. bēros*, *m. kēpala*, *sēsawoh* (E. coast Sumatra), *madang kuaun* (W. coast), *měranti djuntah*, *m. kēpala tupai*, *m. kērang*, *bēnio*, *m. hitam batang*, *m. samak bēnio* (Riouw), *měranti bawang* (Djambi), *měrakunyii bētio*, *mēlas uwai* (Palembang).

Note. Two collections from S.E. Sumatra appear to represent hybrids between this species and *S. parvifolia*.

**141. *Shorea macrantha*** BRANDIS, J. Linn. Soc. Bot. 31 (1895) 97; MERR. En. Born. (1921) 405; SYM. Gard. Bull. S. S. 7 (1933) 131, pl. 34; Mal. For. Rec. 16 (1943) 77, f. 38; BROWNE, For. Trees Sarawak & Brunei (1955) 148; ANDERSON, Gard. Bull. Sing. 20 (1963) 158; ASHTON, Man. Dipt. Brun. Suppl. (1968) 110, f. 13. — *S. hemsleyana* (non KING) FOXW. Mal. For. Rec. 10 (1932) 167, *p.p.* — **Fig. 106 C–C2.**

Small or medium-sized tree. Twig, bud, stipule outside, petiole and nervation beneath densely persistently yellow-brown scabrid tomentose; stipule inside and midrib above densely evenly, nerves above sparsely evenly yellow-brown pubescent. *Twig* 2–4 mm  $\varnothing$  apically, terete, becoming smooth; stipule scars short, dark, horizontal or descending. *Bud* 6 by 3 mm, ovoid, subacute. *Stipule* to 16 by 5 mm, lanceolate, subacute, subpersistent. *Leaves* 6–17 by 2.5–8 cm, of variable size, narrowly ovate, coriaceous; base cordate, subequal; acumen to 1.5 cm long, slender; nerves 13–17 pairs, prominent beneath, at 110° towards the base, 35° towards the apex; tertiary nerves scalariform, prominent beneath, set at c. 90° to the nerves; midrib beneath prominent; midrib and nervation frequently somewhat depressed and the lamina bullate above; *petiole* 5–6 mm long, very short. *Panicles* to 10 cm long, terminal or axillary, terete, persistently fulvous to yellow-brown scabrid pubescent; singly branched, branchlets short, the flowers congested. *Flower bud* to 14 by 4 mm, lanceolate. *Sepals* pubescent on parts exposed in bud; outer 3 deltoid, acute; inner 2 smaller than outer 3, narrowly ovate, with thinner margin. *Petals* dark red within, paler outside (Borneo) or white throughout (Malaya), lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed, tapering to the small subglobose anthers; appendage to connective slender, about as long as anther, becoming reflexed at anthesis. *Ovary* ovoid, shortly pubescent; style filiform, glabrous, about twice as long as ovary. Fruit subsessile. *Calyx* sparsely yellow-brown pubescent; lobes to 2.5 by 2 cm, subequal, ovate, acute, saccate towards the base. *Nut* to 5.5 by 2.5 cm, ellipsoid, acute, pale yellow-brown pubescent.

Distr. *Malesia*: Malaya (Perak, E. coast in Pahang and Johore), E. Sumatra (Indragiri), N.W. Borneo (Central and W. Sarawak).

Ecol. Local, in Mixed Peat Swamp forest at their inland margins, and on white sand terraces (Borneo).

Vern. *Kèpong*, *k. hantu*, *chēngal pasir*, *mēranti pasir* (Malaya), *ēngkabang bungkus* (Sar.), *pērawan lampong kijang* (Iban).

Note. In Perak the tree has an even, soft tomentum and applanate leaves with the nervation not depressed above.

**142. *Shorea hemsleyana*** (KING) KING *ex* FOXW. Mal. For. Rec. 10 (1932) 167, *p.p.*; SYM. Gard. Bull. S. S. 7 (1933) 129, pl. 33; BURK. Dict. (1935) 2011; BROWNE, For. Trees Sarawak & Brunei (1955) 147; ASHTON, Gard. Bull. Sing. 22 (1967) 293.

*a. ssp. hemsleyana*. — SYM. Mal. For. Rec. 16 (1943) 70, f. 38, 43. — *Balanocarpus hemsleyanus* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 134; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 160; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 109. — *Pachychlamys hemsleyanus* RIDL. Fl. Mal. Pen. 1 (1922) 234; FOXW. Mal. For. Rec. 3 (1927) 38.

Small or medium-sized tree. Twig, bud, stipule outside, petiole and nervation below densely persistently yellow-brown scabrid tomentose; stipule inside and midrib above densely evenly, nerves above sparsely evenly, yellow-brown pubescent. *Twig* 2–4 mm  $\varnothing$  apically, terete, becoming smooth; stipule scars short, pale, ascending. *Bud* to 6 by 3 mm, lanceolate, subacute. *Stipule* to 16 by 5 mm, lanceolate, subacute, not at first caducous. *Leaves* 14–35 by 6–15 cm, oblong, coriaceous; base obtuse; acumen to 1 cm long, slender; nerves 14–17 pairs, straight and prominent beneath, at 45°–55°; tertiary nerves remote, scalariform; midrib prominent beneath; nervation somewhat depressed above; *petiole* 14–20 mm long, short. *Panicle* to 25 cm long, axillary, terete, very shortly persistently yellow-brown scabrid pubescent; singly branched, branchlets short, the flowers congested. *Flower bud* to 18 by 6 mm, lanceolate, large. *Sepals* pubescent on parts exposed in bud; 3 outer ovate, acuminate, fimbriate along the lateral margins. *Petals* dark red within, paler outside, lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils, the inner 5 exceeding the style apex; filaments compressed, tapering to the small subglobose anthers; appendage becoming reflexed at anthesis. *Ovary* ovoid, pubescent; style filiform, glabrous, as long as ovary, surmounting a short pubescent stylopodium. *Fruit* subsessile; *pedicel* to 1 mm long, obscure and expanding into fruit. *Calyx* pale fulvous partially caducous pubescent; 3 outer lobes to 25 by 18 mm, as short as or shorter than the ripe nut, lanceolate, acute, chartaceous, thickened and somewhat saccate at the base; 2 inner lobes to 20 by 18 mm, ovate, acute. *Nut* to 7 by 3 cm, ovate, shortly apiculate, densely evenly pale fulvous pubescent.

Distr. Peninsular Thailand, in *Malesia*: N.W. Malaya (Perak), E. Sumatra (Indragiri).

Ecol. Shallow peat swamps; local.

Vern. *Chengal pasir* *daun bēsar*, *mēranti bakau* (Mal.), *m. kunyit* (Sumatra).

*b. ssp. grandiflora* (BRANDIS) ASHTON, Gard. Bull. Sing. 22 (1967) 293; Man. Dipt. Brun. Suppl. (1968) 109, f. 13. — *S. grandiflora* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 93; MERR. En. Born. (1921) 405.

Differing as follows: *Leaves* 10–23 by 4–11 cm; *petiole* 6–12 mm; *panicle* to 4 cm long.

Distr. *Malesia*: N.W. Borneo (Lower Kapuas, Central & West Sarawak).

Ecol. Local in Mixed Dipterocarp forest on leached sandy soils below 400 m.

**143. *Shorea singkawang*** (MIQ.) MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 84; ASHTON, Gard. Bull. Sing. 31 (1978) 47.



**a. ssp. singkawang.** — BURCK, Ann. Jard. Bot. Btzg 6 (1887) 219; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 87; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 307; FOXW. Mal. For. Rec. 10 (1932) 164; BURK. Dict. (1935) 2022; SYM. Mal. For. Rec. 16 (1943) 92, f. 38, 56; ASHTON, Gard. Bull. Sing. 31 (1978) 47. — *Hopea singkawang* MIQ. Sum. 1 (1860) 489, 191; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7 (1868) 379; HEYNE, Nutt. Pl. ed. 2 (1927) 1125. — *S. thiseltonii* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 122; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 77, t. 2, f. 13–14; BRANDIS & GILG in E. & P. Pfl. Fam. ed. 1, 3, 6 (1895) 265; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 155, t. 188; BURK. J. Str. Br. R. As. Soc. 86 (1922) 285; HEYNE, Nutt. Pl. ed. 2 (1927) 1125. — *S. forbesii* KING ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 77, nom. in syn. — *Pachychlamys thiseltonii* RIDL. Fl. Mal. Pen. 1 (1922) 233; FOXW. Mal. For. Rec. 3 (1927) 38. — *Pachychlamys beccarianus* (non DYER ex BRANDIS) RIDL. Fl. Mal. Pen. 1 (1922) 233.

Small, occasionally large tree with somewhat scaly fissured bark. Young twigs, petioles, midrib and fruit calyx caducous ochereous-buff puberulent; panicles, parts of perianth exposed in bud and nut persistently so. *Twig* 2–5 mm  $\varnothing$  apically, typically stout, terete, pale brown,  $\pm$  prominently ribbed; stipule scars short, horizontal. *Leaf bud* to 3 by 2 mm, ovoid, obtuse; stipule to 12 by 6 mm, deltoid-lanceolate, falcate, acute, fugaceous. *Leaves* (8–)12–24 by (2.3–)5.5–9 cm, oblong-lanceolate, coriaceous; base  $\pm$  broadly cuneate; acumen to 1.5 cm long, tapering; nerves 7–12 pairs, ascending, prominent beneath as also the terete midrib; tertiary nerves densely scalariform, sinuate, very slender but evident beneath; *petioles* (6–)12–17 mm long,  $\pm$  stout. *Panicles* to 8 cm long, axillary, erect, with to 1 cm long, short, branchlets bearing to 5 flowers. *Flower buds* to 10 by 4 mm, lanceolate; sepals narrowly ovate, the 3 outer longer, acute, the 2 inner subacuminate; corolla pale red to dark purple-red, variable; *stamens* 15, in 3 unequal verticils; filaments lorate, tapering; anthers subglobose; appendages shorter than anthers, becoming reflexed; ovary narrowly ovoid, tapering into the filiform glabrous somewhat shorter style. *Fruit* sessile; 3 longer calyx lobes to 8 by 0.8 cm, short, lorate, obtuse, expanding into a 14 by 11 mm ovate thickened saccate base; 2 shorter lobes to 3 cm long, with similar base; nut to 6 by 2.5 cm, ellipsoid to ovoid or obovoid, acute.

Distr. Peninsular Thailand, in *Malesia*: Malaya, Lingga, E. Sumatra (Indragiri, Palembang, Lampong).

Ecol. Frequent in lowland Mixed Dipterocarp forest on well drained undulating land, sometimes by streams, below 400 m.

Vern. *Mēranti sēngkawang, sēngkawang* (Malaya, Sumatra), *m. sēngkawang mērah, m. gajah, m. bahu, m. sēkan, siput mēlantai* (Malaya).

**b. ssp. scabrosa** ASHTON, Gard. Bull. Sing. 31 (1978) 48. — *Shorea* sp. C SYM. Mal. For. Rec. 16 (1943) 95.

Differing as follows: Twigs, buds, stipules, petioles,

midrib on both surfaces and nerves beneath, panicles and calyx outside at first densely scabrid fulvous pubescent, becoming sparse on nervation beneath, caducous on calyx but otherwise persistent. *Leaves* thickly coriaceous; base usually with obtuse or cordate base; apex shortly acuminate or obtuse; nerves 12–17 pairs.

Distr. *Malesia*: E. Malaya (coastal Pahang and Trengganu).

Ecol. Forests on low hills, sometimes on soils with impeded drainage, near the coast.

Vern. *Tēngkawang lampong*.

**144. *Shorea retusa*** MEIJER, Act. Bot. Neerl. 12 (1963) 340, pl. 9; Sabah For. Rec. 5 (1964) 141; ASHTON, Man. Dipt. Brun. Suppl. (1968) 117, f. 14.

Small or medium-sized tree. Young parts greyish sericeous, glabrescent except on buds and stipules outside. *Twig* c. 1 mm  $\varnothing$  apically, terete, much branched, smooth; stipule scars pale, short, horizontal. *Bud* to 3 by 2 mm, ellipsoid, obtuse. *Stipule* to 7 by 3 mm, elliptic, obtuse, caducous. *Leaves* 3–9 by 1.5–5 cm, small, elliptic, coriaceous, lustrous; base cuneate; apex retuse; nerves 7–10 pairs, slender, hardly raised beneath, at 40°–60°; tertiary nerves slender, obscure, densely scalariform; midrib prominent beneath, depressed above; *petiole* 6–9 mm long, short. *Panicle* to 10 cm long, terminal or axillary, terete, caducous buff sericeous; singly, or doubly if terminal, branched, branchlets bearing to 7  $\pm$  distichous flowers; *bracteoles* to 3 by 2 mm, elliptic, obtuse, pubescent. *Flower buds* to 8 by 3 mm, lanceolate. *Sepals* densely pubescent on parts exposed in bud; outer 3 ovate, acute; inner 2 shorter, narrower, thinner towards margin than outer 3, fimbriate distally, flanged at base. *Petals* pale yellow, lanceolate, fimbriate, pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed, slender, tapering; anthers subglobose, the inner 5 much longer than the outer 5; appendage to connective slender, c. 4  $\times$  length of anther on inner stamens, c. 2  $\times$  on medium stamens, about same length on outer stamens, becoming reflexed at anthesis. *Ovary* and *stylopodium* narrowly conical, shortly densely buff sericeous, crowned by a short glabrous style. *Fruit pedicel* to 1 mm long. *Calyx bud* sericeous, caducous except at base; 3 longer *calyx lobes* to 10 by 1.8 cm, spatulate, obtuse, c. 4 mm broad above the to 7 by 6 mm ovate saccate thickened base; 3 shorter lobes to 5.5 by 0.4 cm, lorate, obtuse, similar at base. *Nut* to 13 by 2 mm, ovoid; *stylopodium* to 3 mm long.

Distr. *Malesia*: Borneo (S.E. and S. Borneo, Tawau Distr., W. Sarawak).

Ecol. Local on skeletal podsols in Heath forest on coastal hills.

Vern. *Mēranti daun tumpul* (Sarawak), *sēraya daun tumpul* (Sabah), *lampong, lanan putēh, awang, a. pēringet, damar lantang* (S.E. Borneo).

Note. See note under 154. *S. scabrida*.

**145. *Shorea lepidota*** (KORTH.) BL. Mus. Bot. Lugd.-

Bat. 2 (1852) 32; WALP. Ann. 4 (1857) 338; MIQ. Fl. Ind. Bat. 1 (1859) 503; Sum. (1860) 191; DC. Prod. 16, 2 (1868) 629; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 217; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 96; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 304; *ibid.* ed. 2 (1927) 1113, 1114, 1121; Foxw. Mal. For. Rec. 10 (1932) 166; SYM. Gard. Bull. S. S. 7 (1933) 135, pl. 38; Mal. For. Rec. 16 (1943) 73, f. 38, 45; BURK. Dict. (1935) 2014. — *Vatica lepidota* KORTH. Kruidk. (1841) 73; WALP. Rep. 5 (1845) 127; DC. Prod. 16, 2 (1868) 629. — *Vatica stipulosa* MIQ. Sum. (1860) 486; HEYNE, Nutt. Pl. ed. 2 (1927) 1121. — *S. nitens* MIQ. Sum. (1860) 488, 191; DC. Prod. 16, 2 (1868) 632; WALP. Ann. 7 (1868) 379; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 219; HEYNE, Nutt. Pl. ed. 2 (1927) 1121. — *S. stipulosa* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 220. — *S. megistocarpa* Foxw. Mal. For. Rec. 10 (1932) 216, pl. 17; BURK. Dict. (1935) 2019.

Large, buttressed tree. Panicles, parts of perianth exposed in bud and nut persistently buff puberulent; young twigs, midrib above, petioles and fruit calyx caducously so. *Twigs* c. 3 by 2 mm  $\varnothing$  apically,  $\pm$  compressed, becoming smooth, dark brown; stipule scars short, horizontal. *Leaf bud* small, ovoid, acute; *stipule* to 20 by 4 mm,  $\pm$  persistent, lanceolate. *Leaves* 6–14 by 3–6 cm, narrowly obovate to oblong, subcoriaceous; base obtuse or broadly cuneate; acumen to 1 cm long, turned down and frequently bent over on pressing; nerves 14–16 pairs, rather straight and only arching towards the ends, slender but distinctly elevated beneath, evident above as also the densely scalariform tertiary nerves and the midrib; *petioles* 7–11 mm long, slender. *Panicle* to 7 cm long, terminal or axillary, with to 1.5 cm long branchlets bearing to 5 second flowers; *bracteoles* to 4 by 3 mm, oblong, concave, glabrous. *Flower bud* to 10 by 2 mm, lanceolate. *Sepals* ovate, the 3 outer acute, the 2 inner subacuminate. *Petals* cream. *Stamens* 15, in 3 unequal verticils; filaments loriate, tapering; anthers subglobose, becoming reflexed at least on the inner 2 verticils; appendage as long as anthers; *ovary* broadly ovoid, sericeous, crowned by an equally long filiform style. *Fruit pedicel* to 3 by 3 mm,  $\pm$  impressed into the receptacle; 3 longer *calyx lobes* to 11 by 2.5 cm, broadly loriate-spatulate, subacute, c. 11 mm broad above the to 10 by 11 mm suborbicular saccate thickened base; 2 shorter lobes to 7 by 0.7 cm, linear-lanceolate, similar at base; *nut* to 16 by 11 mm, ovoid, apiculate.

Distr. *Malesia*: Malaya, Sumatra (West coast from Pariaman and Ophir to Sibolga and Padang; Kuantan Distr. in east).

Ecol. Frequent or common in Lowland Dipterocarp forest on undulating land and low hills below 350 m.

Vern. *Mēranti langgong*, *m. pala*, *m. sega*, *m. labu*, *damar siput* (Malaya), *meranti katuko*, *katuko*, *m. taratung*, *m. sitarah* (W. coast Sumatra), *m. galur*, *m. sabat* (Kuantan Distr. Sumatra).

146. *Shorea foraminifera* ASHTON, Gard. Bull. Sing. 22 (1967) 295, pl. 40; Man. Dipt. Brun. Suppl. (1968)

108. — *S. teysmanniana* (non DYER *ex* BRANDIS) ASHTON, Man. Dipt. Brun. (1964) 225, *p.p.*

Medium-sized or large buttressed tree. Young parts (leaf and stipule excepting) fugaceous puberulent. *Twig* 1–2 mm  $\varnothing$  apically, at first slightly compressed, becoming terete, smooth; stipule scar short,  $\pm$  horizontal. *Bud* to 8 by 5 mm, ovoid, compressed, subacute. *Stipule* to 10 by 5 mm, oblong to elliptic, obtuse, caducous. *Leaves* 6–9 by 4–7 cm, broadly ovate, coriaceous; base cordate to obtuse; acumen to 5 mm long, somewhat falcate; nerves 8–9 pairs, stout, prominent beneath, with large pore-like axillary domatia, arched, at 55°–70° except at the base; tertiary nerves densely scalariform, obscure; midrib evident, applanate, above, stout, terete, prominent beneath. *Petiole* 10–15 mm long. *Flower* and *inflorescence* unknown. *Fruit pedicel* c. 1 mm long, short. *Calyx* buff puberulent in the basal half, sparsely so distally; 3 longer lobes to 7 by 1.2 cm, spatulate, subacute, c. 4 mm broad above the to 11 by 5 mm ovate thickened saccate base; 2 shorter lobes to 1.5 by 0.4 cm, loriate, acute, similar at base. *Nut* to 15 by 10 mm, ovoid, persistently buff sericeous, shortly apiculate.

Distr. *Malesia*: Borneo (Rejang valley to Brunei).

Ecol. Locally common on shallow peat on alluvium in small swampy valleys; rare on hillsides.

Vern. *Mēranti lobang hidong* (Brun.).

147. *Shorea teysmanniana* DYER *ex* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 100; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 309; *ibid.* ed. 2 (1927) 1126; SYM. Gard. Bull. S. S. 7 (1933) 134, pl. 37; Mal. For. Rec. 16 (1943) 94, f. 38, 57; BROWNE, For. Trees Sarawak & Brunei (1955) 144; ANDERSON, Gard. Bull. Sing. 20 (1963) 159; ASHTON, Man. Dipt. Brun. (1964) 225, f. 16, *p.p.*; *ibid.* Suppl. (1968) 121; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 152. — *S. cochinchinensis* var. *oligoneura* BOERL. Cat. Hort. Bog. 2 (1901) 107. — *S. balangeroides* BOERL. l.c. — *S. paludosa* Foxw. Mal. For. Rec. 10 (1932) 277; BURK. Dict. (1935) 2019.

Medium-sized buttressed tree. Young twig and petiole shortly densely evenly grey-brown caducous pubescent; outside of stipule and leaf bud persistently so. *Twig* c. 2 mm  $\varnothing$  apically, slightly compressed when young, becoming terete, much branched, smooth; stipule scars prominent, cuneate, c. 2 mm long, 1 mm thick, pale,  $\pm$  horizontal. *Leaf bud* 4–8 by 2–5 mm, compressed, ovoid, subacute. *Stipule* to 14 by 5 mm, ovate to oblong, tapering at base, subacute, fugaceous. *Leaves* 7.5–11 by 3.5–7 cm, ovate, entirely glabrous, lustrous,  $\pm$  coriaceous; base obtuse; acumen to 8 mm long; nerves 8–11 pairs, slightly raised beneath, strongly curved, at c. 60°–70° at the base; with or without 1–3 pairs of small basal domatia; midrib narrow, depressed above, sharply prominent beneath. *Petiole* 1.2–1.8 cm long. *Panicle* to 8 cm long, terminal or axillary, terete, shortly buff pubescent; singly branched. *Flower bud* to 14 by 5 mm, ovoid. *Calyx lobes* deltoid, subequal, subacute, densely buff pubescent outside, glabrous within. *Petals*



linear, sparsely pubescent on parts exposed in bud. *Stamens* 15, of 3 lengths; filaments tapering gradually; anther subglobose; appendage to connective short, becoming reflexed. *Ovary* and *stylopodium* narrowly conical, the former densely shortly cream pubescent, the latter more coarsely so; style  $c. \frac{1}{2}$  length of ovary and stylopodium, glabrous. *Fruit calyx* sparsely pubescent towards apex, more densely so towards base; 3 longer lobes to 8 by 1 cm, spatulate, obtuse, to 8 mm broad above the to 9 by 9 mm expanded saccate base; 2 shorter lobes to 3 by 0.5 cm, linear, similar at base. *Nut* to 12 by 8 mm, ovoid, densely shortly buff pubescent; style remnant to 2 mm long, short, acute.

Distr. *Malesia*: Malaya (Selangor), E. Sumatra (Labuan Batu, Bengkalis, Palembang, Siak), Karimun, Banka, Borneo (Lower Kapuas in West Borneo, S.E. Borneo to Sampit, Sarawak and Brunei to W. Sabah).

Ecol. Local, sometimes common, in Mixed Peat Swamp forest, at sea level (one record at 900 m).

Vern. *Mēranti bunga* (Malaya, Sumatra), *m. kait*, *m. daun kalus* (Sumatra), *kēlēpak* (S.E. Borneo), *lintang*, *bangkirai* (Sampit), *mēranti lilin* (Sarawak).

**148. *Shorea argentifolia*** SYM. Gard. Bull. Sing. 17 (1960) 489; BROWNE, For. Trees Sarawak & Brunei (1955) 187; ASHTON, Man. Dipt. Brun. (1964) 179, f. 16; *ibid.* Suppl. (1968) 105; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 98, f. 12.

Medium-sized or large buttressed tree. Young twig, panicle, leaf bud, stipule (both surfaces), petiole, leaf beneath and midrib above shortly evenly densely persistently pink-gold velutinate. *Twig*  $c. 2$  by 1 mm  $\varnothing$  apically, compressed when young, becoming terete, slender, rugulose, glabrous; stipule scars  $c. 1.5$  mm long, short, thin, horizontal, obscure. *Bud*  $c. 4$  by 2.5 mm, ovoid, slightly compressed, subacute. *Stipule* to 20 by 7 mm, not at first caducous, oblong-hastate, acute, base subcordate. *Leaves* 6–11 by 2.5–4.5 cm, oblong-lanceolate, thinly coriaceous; base obtuse; acumen  $c. 5$  mm long; nerves  $c. 20$ –25 pairs, with prominent short secondary nerves, dense, curved towards the margin, at  $c. 66^{\circ}$ – $70^{\circ}$ ; tertiary nerves slender, densely scalariform, at  $c. 90^{\circ}$ ; midrib narrow and slightly depressed above, prominent and terete beneath; *petiole* 8–10 mm long, short, rugose. *Panicle* to 12 cm long, terminal or axillary, compressed; singly branched, the branchlets short, compact, bearing to 6 distichous flowers; *bracteoles* to 8 by 3.5 mm, oblong-elliptic, obtuse, caducous. *Flower bud* to 6 by 3 mm, ovoid, subacute. *Calyx*  $\pm$  patent, densely pubescent outside, glabrous within; 3 outer lobes ovate-deltoid, obtuse; 2 inner lobes  $c. \frac{1}{2}$  as long, ovate, subacute. *Petals* pink, oblong, obtuse, densely pale golden pubescent on parts exposed in bud, hardly connate at base. *Stamens* 15, the 5 inner almost twice as long as the others, reaching the base of the style; filaments tapering gradually; anthers subglobose; appendage to connective short, becoming reflexed. *Ovary* and *stylopodium* pyriform, shortly pubescent; style as long as ovary, glabrous. *Fruit calyx* shortly pubescent; 3

longer lobes to 7.5 by 1.2 cm, narrowly spatulate, narrowly obtuse, 3–4 mm broad above the to 7 by 6 mm ovate thin saccate base; 2 shorter lobes, 10–30 by 1.5 mm, unequal, linear, similar at base. *Nut* to 1.4 by 0.9 cm, ovoid, shortly buff pubescent; style remnant tapering,  $c. 2.5$  mm long.

Distr. *Malesia*: N.E. Borneo (Rejang valley north-eastwards to Sabah and Nunukan).

Ecol. Locally frequent in Mixed Dipterocarp forest, especially on clay soils on undulating land and in valleys, below 600 m.

Vern. *Sēraya daun mas* (Sabah), *mēranti binatoh*, *binatoh* (Sar.), *sēnkajang* (Iban), *mērangan* (Brun.).

**149. *Shorea uliginosa*** FOXW. Mal. For. Rec. 10 (1932) 210, 277; BURK. Dict. (1935) 2023; ASHTON, Gard. Bull. Sing. 22 (1967) 294; Man. Dipt. Brun. Suppl. (1968) 121, f. 15. — *Shorea* sp. FOXW. Mal. For. Rec. 3 (1927) 36. — *S. rugosa* (non HEIM) SYM. Gard. Bull. S. S. 7 (1933) 132, p.p. *quoad spec.* Malay. — *S. rugosa* var. *uliginosa* SYM. Gard. Bull. S. S. 10 (1939) 372; Mal. For. Rec. 16 (1943) 91, f. 38; ANDERSON, Gard. Bull. Sing. 20 (1963) 159.

Large buttressed tree with dark fissured bark. Twig, leaf bud, stipule outside, petiole and leaf beneath densely shortly pale chocolate-brown scabrid tomentose, stipule within, midrib and nerves above evenly so; leaf above puberulent or glabrescent. *Twig* 3–4 mm  $\varnothing$  apically, terete, at first prominently ribbed by the decurrent lateral petiolar bundles, becoming smooth; stipule scars short, pale, horizontal. *Bud* to 6 by 4 mm, ovoid, subacute, compressed. *Stipule* to 14 by 5 mm, elliptic, subacute. *Leaves* 12–22 by 6–12 cm, medium-sized to large, elliptic-oblong, somewhat chartaceous, prominently boat-shaped with the lower surface concave; base broadly cuneate to subcordate; acumen to 1 cm long, acute; nerves 16–21 pairs, prominent beneath, at  $50^{\circ}$ – $70^{\circ}$  except at the base, tertiary nerves scalariform, at  $90^{\circ}$  to the nerves; midrib evident but depressed above, prominent beneath; *petiole* 2.2–3.2 cm long, stout, terete. *Panicle* to 16 cm long, terminal or axillary, ribbed, densely chocolate-brown scabrid tomentose; doubly branched, branchlets bearing to 6  $\pm$  distichous flowers; bracteoles to 3 by 2 mm, elliptic, subacute, pubescent outside, glabrous within, fugaceous. *Flower bud* to 5 by 3 mm, small, ellipsoid. *Sepals* densely pubescent on parts exposed in bud, ovate, acute, the 2 inner smaller than the 3 outer, thinner towards margin, flanged at base. *Petals* pale yellow, elliptic-lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments compressed, slender, tapering; anthers small, subglobose; appendage to connective about as long as anther, becoming reflexed with anther at anthesis. *Ovary* and *stylopodium* conical, densely pubescent; style filiform, glabrous, slender, as long as ovary and stylopodium. *Fruit pedicel* to 1 mm long, short. *Fruit calyx* persistently sericeous towards base, otherwise glabrescent; 2 longer lobes to 6 by 1.2 cm, spatulate, obtuse, to 4 mm broad above the to 5 by 4 mm elliptic

slightly thickened saccate base; 2 shorter lobes to 2 cm long, linear, similar at base. *Nut* to 8 by 6 mm, ovoid, acute, densely buff pubescent.

Distr. *Malasia*: Malaya (Perak, Selangor), E. Sumatra (Labuan Batu, Bengkalis, Palembang, Indragiri, Asahan), Karimun, Banka, W. Borneo (Sampit, Sukadana, Lower Kapuas and Sarawak west of the Baram).

Ecol. Mixed Peat Swamp forest, locally abundant.

Uses. Important as a source of dark red meranti timber.

Vern. *Mēranti sengkawang*, *m. s. mērah*, *sēngkawang*, *m. gajah*, *m. bahru*, *m. sēkam*, *siput mēlantai* (Malaya), *mēranti segar*, *m. kait kait*, *m. daun lebar* (Sumatra), *sēraya* (Banka), *mēranti lang* (Borneo), *lanan buaya* (Sampit), *mēranti buaya*, *m. paya* (Sarawak), *pērawan buaya* (Iban).

**150. *Shorea rugosa*** HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 973; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 96; MERR. En. Born. (1921) 406; SYM. Gard. Bull. S. S. 7 (1933) 132, pl. 35; ASHTON, Man. Dipt. Brun. (1964) 218, f. 16; *ibid.* Suppl. (1968) 118; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 144. — *S. verruculosa* DYER ex BRANDIS, J. Linn. Soc. Bot. 31 (1895) 96, *nom. in syn.* — *S. almon* (non FOXW.) BROWNE, For. Trees Sarawak & Brunei (1955) 150.

Medium-sized or large buttressed tree with dark fissured bark. Young twig, panicle, bud, stipule outside, petiole and nervation beneath densely persistently purplish brown scabrid tomentose; stipule inside, midrib above and leaf beneath shortly evenly so. *Twig* to 2.5 mm  $\varnothing$  apically, ribbed at first, becoming terete, rugulose; stipule scars 2 mm long at first, 0.5 mm thick, pale, slightly descending, falcate or horizontal, obscured by tomentum. *Bud* 4–6 by 3–5 mm, ovoid, subacute. *Stipule* to 14 by 5 mm, oblong-elliptic, subacute. *Leaf* 9–17 by 4–9 cm, oblong-ovate to oblong-obovate; base obtuse; acumen to 9 mm long, broad; margin frequently somewhat revolute; nerves variable, 14–19 pairs, slightly curved, prominent beneath, at 60°–75°; tertiary nerves scalariform, slightly diagonal to nerves; midrib terete and prominent beneath, evident but somewhat depressed above; *petiole* 1.3–2.3 cm long. *Panicle* to 12 cm long, terminal or axillary, lax, terete or slightly compressed; regularly alternatively singly or doubly branched, branchlets bearing to 6 distichous flowers; *bracteoles* to 4 by 3 mm,  $\pm$  elliptic, subacute, pubescent outside, glabrous within, fugaceous. *Flower bud* to 7 by 4 mm, broadly ovoid. *Calyx* densely rust-brown pubescent on parts exposed in bud; lobes subequal, ovate; 3 outer lobes obtuse, 2 inner acute to subacuminate. *Petals* yellow, oblong, obtuse, densely long gold-brown pubescent on parts exposed in bud. *Stamens* 15, the 5 inner somewhat longer and reaching the style apex; filaments much twisted, tapering gradually; anthers subglobose; appendage to connective very short, becoming reflexed. *Ovary* and *stylopodium* conical, densely pale grey pubescent in the distal half, glabrous at base; style short, cylindrical, glabrous.

*Fruit calyx* shortly sparsely fulvous-brown to buff pubescent; 3 longer lobes to 10.5 by 2.5 cm, spatulate, narrowly obtuse, to 4–7 mm broad above the to 1.4 by 1 cm elliptic to ovate saccate thickened base; 2 shorter lobes subequal, to 5 by 0.4 cm, linear, acute, similar at base. *Nut* to 2.3 by 1.5 cm, ovoid, persistently shortly evenly buff fulvous pubescent; style remnant acute.

Distr. *Malasia*: Borneo (Puruktjau and Lower Dayak in S. Borneo, Melawi in W. Borneo, W. Sarawak to S.W. Sabah).

Ecol. Local on leached yellow and occasionally white sandy soils in Mixed Dipterocarp forest and its ecotone with Heath forest below 400 m, subcoastal.

Note. Some collections from South and South-East Borneo bear larger leaves and closely resemble *S. furfuracea* MIQ. (*q.v.*) a Sumatran species that may prove, when flowers are collected, to be conspecific.

**151. *Shorea leprosa*** MIQ. Sum. (1860) 487, 191; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 84; DC. Prod. 16, 2 (1868) 631; WALP. Ann. 7 (1868) 379; SCHEFF. Nat. Tijd. N. I. 31 (1870) 349; DYER, Fl. Br. Ind. 1 (1874) 305; BURCK, Ann. Jard. Bot. Btzg 6 (1887) 215; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 110; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 100; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 55; BECC. For. Born. (1902) 570, 571; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 304; BURK. J. Str. Br. R. As. Soc. 76 (1917) 161, fig.; *ibid.* 79 (1918) 41; *ibid.* 81 (1920) 75, fig.; MERR. En. Born. (1921) 405; RIDL. Fl. Mal. Pen. 1 (1922) 222; BAKER f. J. Bot. 68, Suppl. (1924) 11; THORENAAR, Med. Proefst. Boschw. 16 (1926) 117, t. 20; HEYNE, Nutt. Pl. ed. 2 (1927) 1122; FOXW. Mal. For. Rec. 3 (1927) 26, 3 pl.; SLOOT, in Merr. Pl. Elm. Born. (1929) 203; EDWARDS, Mal. For. Rec. 9 (1931) 144; FOXW. Mal. For. Rec. 10 (1932) 220; DESCH, Mal. For. Rec. 12 (1936) 43, pl. 7, f. 1; *ibid.* 14 (1941) 36, pl. 15, f. 1; *ibid.* 15 (1941) 136, pl. 40, f. 1, pl. 43, f. 3; SYM. Mal. For. Rec. 16 (1943) 75, f. 38, 46, 47; SLOOT, Bull. Bot. Gard. Btzg III, 18 (1949) 262, f. 14; BROWNE, For. Trees Sarawak & Brunei (1955) 110; BACKER & BAKH. f. Fl. Java 1 (1963) 331; ASHTON, Man. Dipt. Brun. (1964) 193, f. 16; *ibid.* Suppl. (1968) 110; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 110. — *Hopea* ? *maranti* MIQ. Sum. (1860) 489, 192; DC. Prod. 16, 2 (1868) 635; WALP. Ann. 7 (1868) 379; HEYNE, Nutt. Pl. ed. 2 (1927) 1122. — *S. maranti* BURCK, Ann. Jard. Bot. Btzg 6 (1887) 217; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 120; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 101; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 306; *ibid.* ed. 2 (1927) 1122. — *S. astrostieta* SCORT. ex FOXW. Mal. For. Rec. 10 (1932) 220, *nom. in syn.*

Large buttressed tree. Twig, panicle, leaf bud, stipule, petiole and nervation beneath persistently evenly densely shortly pale buff pubescent. *Twig* c. 1.5 mm  $\varnothing$  apically, terete, ridged when young, much branched, slender, becoming glabrous, smooth; stipule scars short, horizontal, obscure. *Bud* 3–5 by 2–3 mm, compressed, broadly ovoid, subacute. *Stipule* to 10 by 3.5 mm, oblong to broadly hastate, obtuse, fugaceous. *Leaves* 8–14 by 3.5–5.5 cm, elliptic to



ovate, thinly coriaceous, cream below in mature trees; base obtuse or broadly cuneate; acumen short, to 8 mm long; nerves 12–15 pairs, slender, curved towards margin, set at *c.* 40°–55°; tertiary nerves very slender, densely scalariform, obscure except in young trees; midrib narrow and depressed above and prominent beneath, in young trees beset from the base up more or less its length with lines of small, pale, scale-like domatia occasionally extending also on the nerves; *petiole* 1.0–1.5 cm long. *Panicle* to 14 cm long; terminal or axillary, terete, lax, slender, sparsely or densely evenly persistently pale brown to cream pubescent; regularly singly, rarely doubly, branched, branchlets short, bearing to 12 ± secund flowers; *bracteoles* to 3 by 2 mm, elliptic, obtuse, shortly pubescent, fugaceous. *Flower bud* to 6 by 3 mm, fusiform, subacute. *Calyx* densely pale brown pubescent outside, glabrous within; 3 outer lobes narrowly ovate, obtuse; 2 inner lobes broadly ovate, shorter, shortly acuminate. *Petals* pale yellow, narrowly oblong, densely pale yellowish grey pubescent on parts exposed in bud. *Stamens* 15, the inner 5 twice as long as the others and reaching half the length of the style; filaments long, tapering gradually; anthers subglobose; appendage to connective short, becoming reflexed. *Ovary* and *stylopodium* ovoid, glabrous; style filiform, twice as long as ovary and stylopodium, glabrous. *Fruit calyx* glabrescent or persistently shortly pubescent at base; 3 longer lobes to 10 by 2 cm, spatulate, obtuse, *c.* 5 mm broad above the to 8 by 6 mm thickened elliptic shallowly saccate base; 2 shorter lobes to 5.5 by 0.3 cm, unequal, similarly saccate at base. *Nut* to 2 by 1.3 cm, ovoid, densely pale buff pubescent; style remnant *c.* 2 mm long, tapering, acute.

Distr. Thailand (Pattani) and in *Malesia*: Malaya (excluding seasonal areas), Sumatra, Banka, Billiton, Borneo.

Ecol. Common, often abundant, on deep clay soils in Mixed Dipterocarp forest below 700 m.

Vern. *Měrantī tēmbaga*, *m. bētul*, *m. bunga*, *m. lampong*, *m. tēmak*, *m. hijau*, *m. sabut*, *m. kait kait* (Malaya, Sumatra), *m. sēpang* (Palembang), *lampong* (Kutei), *pěrawan lop* (Sarawak), *sěraya tēmbaga* (Sabah), *kōntoi* (Melawi), *lěntang* (Sampit) and many others.

**152. *Shorea platycarpa*** HEIM, Bull. Mens. Soc. Linn. Paris 2 (1891) 956; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 94; BECC. For. Born. (1902) 510; MERR. En. Born. (1921) 406; SYM. Gard. Bull. S. S. 7 (1933) 133, pl. 36; Mal. For. Rec. 16 (1943) 88, f. 38, 53; BROWNE, For. Trees Sarawak & Brunei (1955) 142; ANDERSON, Gard. Bull. Sing. 20 (1963) 159; ASHTON, Man. Dipt. Brun. (1964) 211; *ibid.* Suppl. (1968) 115. — *S. leprosula* (non MIQ.) BOERL. Cat. Hort. Bog. 2 (1899) 110. — *S. palustris* RIDL. Fl. Mal. Pen. 1 (1922) 224; FOXW. Mal. For. Rec. 3 (1927) 381; *ibid.* 10 (1932) 212; BURK. Dict. (1935) 2019. — **Fig. 106 B–B3.**

Large buttressed tree. Young twig, panicle, bud and petiole densely shortly persistently rust-brown scabrid

pubescent, sparsely so on stipule, midrib above and leaf beneath, glabrescent on leaf above. *Twig c.* 3 mm Ø apically, stout, ridged, verrucose; stipule scars short, narrow, ascending, obscure. *Bud* 4–6 by 3.5–5 mm, broadly ovoid, obtuse. *Stipule* to 10 by 6 mm, ovate, subacute. *Leaves* 9–17 by 5.5–10 cm, medium-sized to large, elliptic-oblong or broadly ovate, thinly coriaceous; base obtuse; acumen to 1 cm long, short, broad; nerves 16–20 pairs, close, straight, curved near margin, with or without scale-like axillary domatia (without in old trees); tertiary nerves distant, scalariform, slender but distinct, slightly diagonal to nerves; midrib broad, terete beneath, narrow yet hardly depressed above; *petiole* 1.5–2 cm long, stout. *Panicle* to 9 cm long, terminal or axillary, ribbed, straight, densely shortly persistently rust-brown scabrid pubescent; singly or doubly branched; *bracteoles* to 4 by 3 mm, broadly ovate, acute, densely shortly pubescent outside, glabrous within. *Flower bud* to 3 by 4 mm, ellipsoid-ovoid, obtuse. *Calyx* densely pubescent outside, glabrous within; 3 outer lobes ovate, obtuse, *c.* 2 × length of 2 inner lobes; inner lobes broadly ovate, prominently caudate. *Petals* pale yellow, narrowly lanceolate, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 unequal verticils, the longest almost as long as the ovary; filaments compressed, tapering gradually; anthers subglobose; appendage to connective as long as anther, becoming reflexed. *Ovary* and *stylopodium* glabrescent, narrowly ovoid; style as long as ovary and stylopodium, filiform, glabrous. *Fruit* subsessile, calyx shortly persistently pubescent towards base, otherwise glabrescent; 2 longer lobes to 6.5 by 1.2 cm, narrowly spatulate, narrowly obtuse, to 4 mm broad above the to 5 by 4 mm elliptic slightly thickened saccate base; 2 shorter lobes to 2 cm long, linear, similar at base. *Nut* to 8 by 6 mm, ovoid, densely buff pubescent; style remnant short, acute.

Distr. *Malesia*: Malaya (both coasts), Sumatra (Palembang, Siak), Banka, Billiton, Borneo (except E. Sabah).

Ecol. Locally common, widespread, in Mixed Peat Swamp forests.

Vern. *Měrantī paya*, *m. kait kait*, *m. sěgar* (Malaya).

Note. With close affinities to *S. leprosula* of the lowland forests.

**153. *Shorea curtisii*** DYER *ex* KING, J. R. Soc. Beng. Sc. 62, 2 (1893) 111; BRÜHL & KING, Ann. R. Bot. Gard. Calc. 5, 2 (1896) 152, t. 185; ASHTON, Gard. Bull. Sing. 31 (1978) 48.

*a. ssp. curtisii.* — BRANDIS, J. Linn. Soc. Bot. 31 (1895) 101; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 58; Fl. Mal. Pen. 1 (1922) 223; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 299; *ibid.* ed. 2 (1927) 1116; BURK. J. Str. Br. R. As. Soc. 81 (1920) 71, fig.; FOXW. Mal. For. Rec. 1 (1921) 78; *ibid.* 3 (1927) 39; *ibid.* 10 (1932) 226; BURK. Dict. (1935) 2009; CORNER, Wayside Trees 1 (1940) 213; SYM. Mal. For. Rec. 16 (1943) 67, f. 38, 40, 41;



Fig. 112. Habit of a big tree of *Shorea curtisii* DYER ex KING. Note man at bottom left from tree, one tree climber halfway up, one in fork of first branch. Brunei, Labi Road (Photogr. ASHTON).

BROWNE, For. Trees Sarawak & Brunei (1955) 147; ASHTON, Man. Dipt. Brun. (1964) 185, f. 16, pl. 45 (habit, bark); *ibid.* Suppl. (1968) 106; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 103; BURGESS, F.R.I. Res. Pamphlet 66 (1975). — Fig. 6, 112, 113.

Large buttressed tree. Young twig, panicle, leaf bud, stipule outside (glabrescent within) petiole, and

midrib and nerves beneath densely shortly evenly caducous pale pink-brown to grey puberulent. *Twig* c. 1.5 mm  $\varnothing$  apically, terete, much branched, slender, becoming smooth, glabrous; stipule scars short, cuneate, horizontal, obscure. *Bud* 4–9 by 2.5–3.5 mm, subacute, ovate to slightly falcate, slightly constricted at base. *Stipule* to 10 by 4 mm, obtuse, slightly constricted at base. *Leaves* 6–9 by 2.5–3.5 cm, ovate-lanceolate, pale pink to grey lepidote beneath; base broadly cuneate; acumen to 8 mm long, narrow; nerves 9–11 pairs, curved, slender, hardly raised beneath, at 50°–60°; tertiary nerves slender, densely scalariform, obscure, diagonal to nerves; midrib slender, prominently terete beneath, narrow depressed above; *petiole* 1–1.3 cm long, slender. *Panicle* to 6 cm long, terminal or axillary, terete; singly or doubly branched, branchlets short, bearing to 12 distichous flowers; *bracteoles* to 2.5 by 2 mm, subacute, shortly pale grey pubescent outside, glabrous within, fugaceous. *Bud* to 5 by 3 mm, ovoid, obtuse. *Calyx* densely pale grey puberulent outside, glabrous within; lobes ovate, 3 outer longer, narrow, obtuse; 2 inner broad, acuminate. *Petals* pale cream yellow (Malaya) or deep crimson (Borneo), linear, obtuse, connate at base, densely pubescent on parts exposed in bud. *Stamens* 15, the outer 10 sometimes aborting, the inner 5 longer, reaching the ovary apex; filaments tapering gradually to the anther, markedly gibbous; anther subglobose; appendage to connective short on outer 10 stamens, rudimentary on inner 5, reflexed. *Ovary* and *stylopodium* ovoid, densely pubescent except at base; style short, broadening at the apex, glabrous. *Fruit* pedicel c. 1 mm long, short. *Fruit calyx* puberulent at base, otherwise glabrous; 3 longer lobes to 7 by 1 cm, narrowly spatulate; apex narrowly obtuse, tapering to c. 2.5 mm broad above the to 6 by 5 mm ovate shallowly saccate thickened base; 2 shorter lobes to 4 by 0.3 cm, unequal, linear, similarly expanded at base. *Nut* to 1.2 by 0.9 cm, ovoid, tapering to a short 1 mm long apiculus, shortly densely pale buff pubescent.

Distr. Peninsular Thailand (Pattani) and in *Malaysia*: Malaya, Sumatra (Singkep, Lingga), Borneo (Rejang valley to S.W. Sabah).

Ecol. Deep dry soils on coastal hills; in Malaya continuing up ridges and gregarious in Hill Dipterocarp forests between 300–850 m. See for detailed ecology BURGESS (1975).

Uses. The major dark red meranti timber in Malayan hills.

Vern. *Sĕraya*, *s. sabut*, *s. bukit*, *mĕranti lampong*, *m. sutra*, *m. sĕraya*, *penak lampong*, *bohor*, *jarang*, *mĕntanam* (Malaya), *sĕraya* (Riouw).

Note. Small groups of hybrid trees between this species and *S. leprosula* exist on Bukit Timah, Singapore and Bukit Lagong, Selangor; this subspecies may have the same origin. The two species often occur together at the margin of their respective ecological ranges, and it is curious that morphologically intermediate trees are not more common.



**b. ssp. grandis** ASHTON, Gard. Bull. Sing. 31 (1978) 48. — *Shorea* sp. B SYM. Mal. For. Rec. 16 (1943) 95.

Differing as follows: *Twig* c. 4 by 2 mm  $\varnothing$  apically, compressed. *Leaves* 11–17 by 5–8 cm, elliptic; nerves 10–13 pairs; *petiole* 2–2.5 cm long.

Distr. *Malesia*: Malaya (Perak).

Ecol. As *ssp. curtisii*.

Vern. *Sĕraya daun besar*.

**154. *Shorea scabrida*** SYM. Gard. Bull. S. S. 8 (1935) 287, pl. 28; BROWNE, For. Trees Sarawak & Brunei (1955) 143; ANDERSON, Gard. Bull. Sing. 20 (1963) 159; ASHTON, Man. Dipt. Brun. (1964) 221, f. 16, pl. 58 (habit, stem-base); *ibid.* Suppl. (1968) 119; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 146.

Medium-sized tree. Young twig, panicle, leaf bud, outside of stipule, midrib on both surfaces and nervation beneath  $\pm$  persistently densely tawny-brown scabrid pubescent. *Twig* c. 2 mm  $\varnothing$  apically, much branched, terete, becoming smooth, glabrous; stipule scars short, horizontal, obscure. *Bud* 2.5–5 by 1.5–3 mm, ovoid, compressed, obtuse. *Stipule* to 6 by 3 mm, oblong, obtuse, fugaceous. *Leaves* 5–9 by 3–5 cm, small, obovate or elliptic, coriaceous; base broadly cuneate, rarely obtuse; apex retuse, obtuse or with to 5 mm long acumens; nerves 8–11 pairs, slightly curved, at c. 25°–40°, rarely with domatia; tertiary nerves slender, scalariform, diagonal to nerves; midrib narrow and depressed above, terete and prominent beneath; *petiole* 9–11 mm long, short, rugose. *Panicle* to 8 cm long, terminal or axillary, short, terete or slightly compressed; singly, rarely doubly, branched, branchlets short, rather irregular, bearing to 7  $\pm$  distichous flowers; *bracteoles* to 3.5 by 2.5 mm, ovate, subacute, shortly buff pubescent outside, glabrescent within. *Flower bud* to 8 by 3.5 mm, lanceolate, obtuse. *Calyx* densely pale buff pubescent outside, glabrous within; 3 outer lobes deltoid to ovate, subacute; 2 inner lobes smaller, broadly ovate, subacuminate. *Petals* cream, pink at base, lanceolate, acute, densely pubescent on parts exposed in bud. *Stamens* 15, in 3 distinct verticils; filaments tapering gradually; anther subglobose; appendages to connective slightly longer than anther, the longest reaching to the base of the style, becoming reflexed. *Ovary* and *stylopodium* narrowly conical, densely pubescent except at the base; style almost half length of ovary and *stylopodium*, glabrous. *Fruit calyx* glabrescent; 3 longer lobes to 7 by 1.5 cm, spatulate, c. 3 mm wide above the to 7 by 5 mm ovate saccate thickened base; 2 shorter lobes to 3 by 0.3 cm, linear, similar at base. *Nut* to 10 by 8 mm, ovoid, shortly densely buff pubescent, shortly apiculate.

Distr. *Malesia*: E. Sumatra (Lower Langkat, Langsa, Lingga), Borneo.

Ecol. Local in fresh water swamp forest on shallow peat overlying sand, and on skeletal sandy soil on ridges and plateaux, in Heath forest and Mixed Dipterocarp forest.

Vern. *Kulap daun, mĕranti tembalang, m. pepak lantai, pĕngĕrawan* (W. Borneo), *lanan lutung, l.*

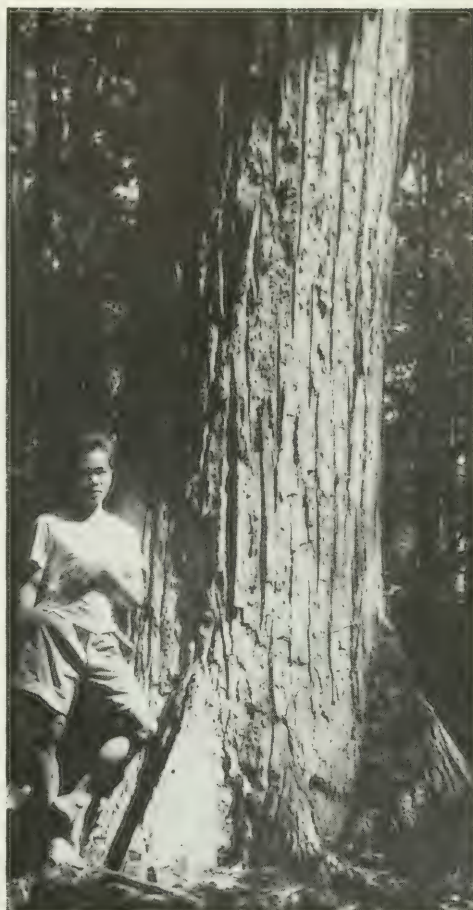


Fig. 113. Trunk-base of *Shorea curtisii* DYER ex KING, with V-shaped fissure bark. Brunei (Photogr. ASHTON).

*tĕmbaga* (S.E. Borneo), *bangkirai lutung* (S.E. Borneo), *sĕraya lop* (Sabah), *mĕranti tĕlur* (Kedayan), *m. lop* (Sarawak).

Notes. A variable species with several local ecotypes varying principally in leaf shape and persistence and evenness of tomentum.

Doubtfully distinct from *S. retusa*; apparently intermediate forms occur in S.E. Borneo (sterile collections).

**155. *Shorea revoluta*** ASHTON, Gard. Bull. Sing. 19 (1962) 304, pl. 26; Man. Dipt. Brun. (1964) 215, f. 16; *ibid.* Suppl. (1968) 117; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 142.

Medium-sized tree. Twig, panicle, leaf bud, stipule outside (pubescent within) and petiole densely shortly



Fig. 114. Hill dipterocarp forest with *Shorea ovata* DYER ex BRANDIS amidst the common bertam palm, *Eugeissona triste*. Malaya (Photogr. WYATT-SMITH, 1948).

pale brown to fulvous somewhat scabrid pubescent; nervation beneath and midrib above more sparsely so, glabrescent. *Twig* c. 2–3 mm  $\varnothing$  apically, at first slightly ribbed and compressed, becoming terete, stout, smooth, glabrous: stipule scars to 2 mm long at first, horizontal, narrow, obscure. *Bud* 4–7 by 3–5 mm, ovoid, compressed, subacute. *Stipule* to 1.5 by 0.7 cm, elliptic to oblong, obtuse. *Leaves* 10–15 by 5.5–10 cm,

ovate, coriaceous, lustrous; base obtuse to subcordate; acumens to 1.5 cm long, narrow; margin revolute; nerves 9–12 pairs, curved, prominent beneath, well spaced, at to  $90^\circ$  at the base and down to  $45^\circ$  towards the apex, with small glabrous axillary domatia; tertiary nerves slender, scalariform, diagonal to nerves; midrib narrow and slightly depressed above, prominent beneath; *petiole* 1.3–1.5 cm long. *Panicle* to 22 cm



long, singly or doubly branched, terminal or axillary, straight. *Flower bud* to 7 by 4 mm. *Sepals* narrowly deltoid-ovate, subacute, pubescent on parts exposed in bud, the inner 2 smaller than the outer 3. *Petals* lanceolate, hispid on parts exposed in bud. *Stamens* 15, in 3 unequal verticils; filaments slender, compressed, tapering to the small subglobose anthers; appendage to connective slender, short, as long as anther, anthers and appendages becoming reflexed. *Ovary* and *stylopodium* narrowly conical, densely pubescent; style slender, filiform, glabrous, c.  $\frac{1}{2}$  length of ovary and stylopodium. *Fruit pedicel* to 1.5 cm long. *Calyx* puberulent; 3 longer lobes to 7.5 by 1.3 cm, narrow, spatulate, obtuse, c. 3 mm broad above the c. 6 by 5 mm ovate thickened saccate base; 2 shorter lobes to 3.5 by 0.2 cm, subequal, linear, acute, similar at base. *Nut* to 1.5 by 0.8 cm, ovoid, pale buff pubescent; style remnant c. 1.5 mm long, tapering.

Distr. *Malesia*: Borneo (N.E. Sarawak, Brunei, S.W. Sabah).

Ecol. Local, Heath forest on terraces and sandstone plateaux to 1200 m.

Vern. *Mēranti kērangas* (Sarawak), *sēraya daun tajam* (Sabah).

**156. *Shorea ovata*** DYER *ex* BRANDIS, J. Linn. Soc. Bot. 31 (1895) 91; MERR. En. Born. (1921) 406; SYM. Gard. Bull. S. S. 7 (1933) 140, pl. 40; Mal. For. Rec. 16 (1943) 82, f. 38, 50; BROWNE, For. Trees Sarawak & Brunei (1955) 148; ASHTON, Man. Dipt. Brun. (1964) 230, f. 16; *ibid.* Suppl. (1968) 112; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 127, pl. 8A. — *S. parvifolia* (non DYER) KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 112, *p.p.*; FOXW. Mal. For. Rec. 10 (1932) 199. — *S. plagata* FOXW. Philip. J. Sc. 13 (1918) Bot. 192; *ibid.* 67 (1938) 308. — *S. agsaboensis* W.L. STERN, Brittonia 17 (1965) 36, f. 1–2; ROJO, Pterocarpus 3 (1977) 70, fig. — **Fig. 114.**

Small or medium-sized tree. Young twig, panicle, leaf bud, stipule (both surfaces), petiole, midrib above and leaf beneath densely persistently evenly ochraceous to rust pubescent, scabrid on raceme and nervation beneath. *Twig* c. 1 mm  $\varnothing$  apically, slender, much branched, terete, becoming smooth, glabrous; stipule scars c. 1 mm long, thin, slightly descending. *Bud* 3–6 by 1.5–3 mm, ovoid, obtuse. *Stipule* to 13 by 5 mm, ovate, subacute, fugaceous. *Leaves* 4–8 by 2.5–4.5 cm, small, coriaceous, broadly ovate; base subequal to equal, obtuse; acumens to 1 cm long, narrow; margin slightly revolute; nerves 8–10 pairs, curved, prominent beneath, at c. 50°–70°, with (in Borneo) small pilose axillary domatia; tertiary nerves slender, densely scalariform, set diagonally to the nerves; midrib slightly depressed above; *petiole* 1–1.3 cm long. *Panicle* to 11 cm long, terminal or axillary, terete or slightly compressed; singly or doubly branched, branchlets to 3 cm long, bearing to 8  $\pm$  distichous flowers; *bracteoles* to 3.5 by 2 mm, oblong, obtuse, sparsely puberulent outside, glabrescent within. *Flower bud* to 6 by 2.5 mm, ovoid, subacute. *Calyx* densely golden-brown pubescent outside, gla-

brescent within; 3 outer lobes narrowly ovate, acuminate; 2 inner shorter, broader, more acuminate; *petals* pale pink with cream margin, lanceolate, obtuse, pubescent on parts exposed in bud, loosely connate on falling. *Stamens* of 3 lengths, the outer 5 often aborting, the inner 5 about twice their length; filaments tapering gradually; anthers subglobose, narrower apically; appendage to connective short, becoming reflexed. *Ovary* ovoid, with a band of hairs at the apex, otherwise glabrous, tapering into the rather short glabrous style. *Fruit calyx* glabrescent,  $\pm$  persistently puberulent at base; 3 longer lobes to 5.5 by 1 cm, spatulate, obtuse, to 4 mm broad above the to 7 by 6 mm ovate shallowly saccate thickened base; 2 shorter lobes to 3 by 0.3 cm, subequal, linear, similarly saccate at base. *Nut* to 11 by 8 mm, broadly ovoid, tapering, shortly evenly densely buff pubescent; style remnant to 2.5 mm long, acute.

Distr. *Malesia*: Malaya, Sumatra (W. coast: Tapanuli, Sibolga to Painan, Bangkinang; P. Musala), Borneo (Kapas hinterland, Sarawak to S.W. Sabah, S.E. Borneo), Philippines (Mindanao).

Ecol. Sandy soils on coastal hills (especially in Borneo); inland ridges to 1500 m (especially in Malaya and Sumatra).

Vern. *Mēranti sarang punai bukit* (Malaya), *mandirawan* (Sumatra), *sēraya punai bukit* (Sabah).

Notes. Formerly I pointed out (Gard. Bull. Sing. 31, 1978, 47) that *S. plagata* and *S. agsaboensis* (from Mindanao) represented the same species and referred these names to *S. pauciflora*, owing to the leaf shape and 8 pairs of nerves, pointing out, however, that the Philippine plants differed in the usually small leaf-size and the usual but not consistent presence of small axillary domatia up to the midrib. I also indicated that flowers would be needed for confirmation. J. P. ROJO has now collected and described (1977, *l.c.*) these flowers (ROJO 292, Agusan del Norte, Mindanao) and correctly pointed out that they place the species in a different section, *Mutica*, *S. pauciflora* being in *sect. Brachypterae*. ROJO's excellent field description alludes to the fissured bark and bluish-red corolla, pink at the base. This matches *Shorea sect./subsect. Mutica*, while the description of the corolla is distinctive and clearly matches that of *S. ovata*, in which the leaves also bear 8 pairs of nerves and pubescent axillary domatia. Though not closely resembling the leaves of *S. ovata* as it occurs in Borneo, the Philippine specimens so much resemble specimens from Sumatra and West Malaysia, that I am convinced of their conspecificity. This conclusion is strengthened by ROJO's comment that it is in Mindanao a species of high ridges, exactly as is *S. ovata*, except in northern Borneo where it spreads down onto sandy soils in the lowlands.

**157. *Shorea rubra*** ASHTON, Gard. Bull. Sing. 19 (1962) 309, pl. 28; Man. Dipt. Brun. (1964) 217, f. 16; *ibid.* Suppl. (1968) 118; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 144.

Medium-sized or large buttressed tree with dark

bark. Twig, panicle, bud, stipule (both surfaces, shorter within), petiole, midrib above and leaf beneath densely persistently deep rufous-brown scabrid pubescent. *Twig* to 1.5 mm  $\varnothing$  apically, terete, much branched, becoming smooth; stipule scars c. 1 mm long, short, narrow, descending. *Bud* 4–7 by 3–4.5 mm, compressed, ovoid, broadly acute. *Stipule* to 16 by 5 mm, hastate, subacute. *Leaves* 8–13 by 4–7.5 cm, broadly ovate, thinly coriaceous; base obtuse; acumen to 1.3 cm long; margin narrowly revolute; nerves 11–13 pairs, prominent beneath, curved distally, at 40°–50°; tertiary nerves slender, densely scalariform, diagonal to nerves; midrib prominently terete beneath, narrow and shallowly depressed above; *petiole* 1–1.4 cm long. *Panicle* to 14 cm long, terminal or axillary, terete, rather straight and ridged; singly or doubly regularly branched, branchlets short, compact, bearing to 5 distichous flowers; *bracteoles* to 4 by 3.5 mm, broadly ovate, subacute, imbricate round the bud, shortly pale buff pubescent outside, more sparsely so within. *Flower bud* to 7 by 4 mm, ellipsoid to subglobose, obtuse. *Calyx* densely pale grey pubescent outside, glabrous within; 3 outer lobes deltoid-ovate, obtuse; 2 inner lobes smaller, broadly ovate, acute. *Petals* pale yellow, narrowly oblong, subacute, shortly pubescent on parts exposed in bud. *Stamens* 15, of 3 lengths, the inner 5 being almost twice as long as the others; filaments of outer 10 tapering gradually to anther, filaments of inner 5 oblong, broad, tapering abruptly distally; anthers subglobose; appendage to connective shorter than anther, becoming slightly reflexed. *Ovary* and *stylopodium* ovoid-conical, densely pubescent except at the base; style shorter than ovary, glabrous. *Fruit calyx* sparsely puberulent, glabrescent; 3 longer lobes to 11 by 1.6 cm, narrowly spatulate, obtuse, to 5 mm broad above the to 8 by 6 mm deeply saccate thickened base; 3 shorter lobes to 4.5 by 0.4 cm, subequal linear, acute, similarly expanded at base. *Nut* to 10 by 9 mm, broadly ovoid, shortly densely evenly pale buff pubescent. Style remnant to 2 mm long, tapering.

Distr. *Malesia*: Northern Borneo (West Borneo; Rejang valley to West Sabah and Tawau).

Ecol. Uncommon, on sandy clay soils on low hills and ridges to 1350 m.

Vern. *Mēranti mērah kesumba* (Brun.).

**158. *Shorea dasyphylla*** Foxw. Mal. For. Rec. 10 (1932) 224, pl. 18; BURK. Dict. (1935) 2010; SYM. Mal. For. Rec. 16 (1943) 69, f. 38, 42; BROWNE, For. Trees Sarawak & Brunei (1955) 138; ASHTON, Man. Dipt. Brun. Suppl. (1968) 106, f. 13.

Medium-sized or large buttressed tree. Twigs, buds, stipules, petioles, leaf beneath and midrib above densely persistently shortly scabrid golden-brown pubescent, leaf above puberulent. *Twig* c. 2 mm  $\varnothing$  towards apices, terete; stipule scars short, obscure. *Bud* to 3 by 2 mm, ovoid, obtuse. *Stipules* to 6 by 4 mm, broadly ovate, obtuse, caducous. *Leaves* 7–14 by 3–6 cm, ovate to elliptic, coriaceous, margin somewhat revolute; base obtuse or broadly cuneate;

acumen to 1 cm long, slender; nerves 11–15 pairs, prominent beneath, at 50°–65°; tertiary nerves scalariform, elevated beneath; midrib  $\pm$  depressed above, prominently terete, striated, beneath; *petiole* 12–15 mm long. *Panicle* to 8 cm long, terminal or axillary, terete or ribbed, densely persistently shortly golden-brown scabrid pubescent; singly branched, branchlets to 1 cm long, bearing to 4 flowers; *bracteoles* to 3 by 2 mm, elliptic, obtuse, pubescent, caducous. *Flower bud* to 4 by 3 mm, ovoid. *Calyx* densely pubescent outside, sparsely so within; 3 outer lobes deltoid-ovate, 2 inner lobes smaller, broadly ovate. *Petals* cream-yellow, oblong, obtuse, densely pubescent on parts exposed in bud. *Stamens* 15, of 3 lengths, the inner 5 about twice the length of the others; filaments tapering gradually to the subglobose anthers; appendages to connective short, slender, becoming reflexed. *Ovary* and *stylopodium* ovoid to conical, densely pubescent; style shorter than ovary, glabrous. *Fruit pedicel* to 2 mm long. *Calyx* glabrescent; 3 longer lobes to 9 by 1.3 cm, narrowly spatulate, subacute, c. 4 mm broad above the to 8 by 6 mm ovate saccate thickened base; 2 shorter lobes to 40 by 4 mm, linear, similar at base. *Nut* to 18 by 9 mm, ovoid, shortly evenly buff pubescent, shortly apiculate.

Distr. *Malesia*: Malaya (excluding seasonal area), Sumatra (Palembang north to Langkat and Labuan Batu in east), Borneo (Sarawak west of the Lupar).

Ecol. Scattered in Mixed Dipterocarp forest on well drained flat land and low hills and occasionally to 1000 m.

Vern. *Mēranti batu*, *m. tēmbaga*, *m. sarang punai*, *m. sabut* (Mal.), *m. gambong*, *m. sabut*, *kētuho andilan* (Sumatra).

**159. *Shorea parvifolia*** DYER, Fl. Br. Ind. 1 (1874) 305; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 112, *p.p.*; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 92, *p.p.*; RIDL. Agr. Bull. Str. & F. M. S. 1 (1901) 57; Fl. Mal. Pen. 1 (1922) 224; BURK. J. Str. Br. As. Soc. 81 (1921) 517; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 306; *ibid.* ed. 2 (1927) 1123; Foxw. Mal. For. Rec. 3 (1927) 31; SLOOT, in Merr. Pl. Elm. Born. (1929) 203; EDWARDS, Mal. For. Rec. 9 (1931) 146; SYM. Gard. Bull. S. S. 7 (1933) 137, pl. 39; Mal. For. Rec. 16 (1943) 85, f. 37C, 38, 51; BROWNE, For. Trees Sarawak & Brunei (1955) 141; ASHTON, Gard. Bull. Sing. 20 (1963) 278; Man. Dipt. Brun. (1964) 206, f. 16; *ibid.* Suppl. (1968) 113; MEIJER & WOOD, Sabah For. Rec. 5 (1964) 128, f. 1c.

*a. ssp. parvifolia*. — *S. scutulata* KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 110; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 102; BURK. J. Str. Br. R. As. Soc. 81 (1920) 71, fig.; RIDL. Fl. Mal. Pen. 1 (1922) 222; Foxw. Mal. For. Rec. 10 (1932) 201; BURK. Dict. (1935) 2022. — *S. gentilis* PARIJS in Fedde, Rep. 33 (1933) 244.

Large tree. Young twig, panicle, leaf bud, stipule, petiole and midrib above shortly evenly persistently pale brown pubescent or glabrous, otherwise glabrous. *Twig* c. 2 mm  $\varnothing$  apically, terete, much branched, becoming glabrous, smooth; stipule scars



short, inconspicuous. *Bud* 4–7 by 3–5 mm, ovoid, compressed, obtuse. *Stipule* to 12 by 4 mm, oblong to ovate, obtuse. *Leaves* 5–9 by 2.5–5 cm, broadly ovate, thinly coriaceous, base obtuse or cordate with occasionally a pair of large pale scale-like domatia; acumen to 1 cm long, margin slightly revolute; nerves 10–13 pairs, slightly curved, slender, hardly elevated beneath; tertiary nerves slender, closely scalariform diagonal to nerves, midrib narrow and depressed above; *petiole* 1–1.5 cm long. *Panicle* to 12 cm long, terminal or axillary, slender, terete or slightly compressed; regularly singly, rarely doubly, branched, branchlets short, compact, bearing to  $8 \pm$  second flowers; bracteoles to 6 by 3 mm, elliptic-oblong, obtuse, shortly sparsely pale buff pubescent. *Bud* to 7 by 5 mm, broadly ovoid to subglobose, obtuse. *Calyx* densely pubescent outside, glabrous within; 3 outer lobes deltoid-ovate; 2 inner lobes smaller, broadly ovate, acute, thin at base. *Petals* cream suffused with pink at base, oblong, obtuse, shortly pubescent on parts exposed in bud. *Stamens* 15, of 3 lengths, the 5 inner about twice length of others; filaments tapering gradually; anther subglobose; appendage to connective short, slender, becoming reflexed. *Ovary* and *stylopodium* ovoid to conical, densely pubescent except at base; style shorter than ovary, glabrous. *Fruit* calyx shortly sparsely pale brown pubescent; 3 longer lobes to 9 by 1.5 cm, thin, spatulate, obtuse, c. 4 mm broad above the c. 5.5 by 5 mm elliptic thickened saccate base; 2 shorter lobes to 3.5 by 0.2 cm, linear, subequal, similarly saccate at base. *Nut* to 14 by 7 mm, ovoid, shortly buff pubescent, style remnant c. 2.5 mm long, tapering, acute.

Distr. Thailand (Pattani) and in *Malesia*: Malaya, Sumatra, P. Musala, Borneo.

Ecol. Perhaps the commonest dipterocarp in the region, on clay soils on hills below 800 m.

Uses. A very important timber tree, the main source of light red meranti.

Vern. *Mēranti sarang punai*, *m. bunga*, *m. samak*, *m. daun halus*, *m. choh*, *m. lēmēsa bung* (Malaya), *m. sabut*, *m. kapala tupai*, *tambong sawa* (Sumatra), *sawang puteh*, *awang belah* (Mahakam), *ponga pipit*, *p. payur*, *p. bahaya* (Melawi), *lampung*, *l. nasi*, *l. tēm̃baga*

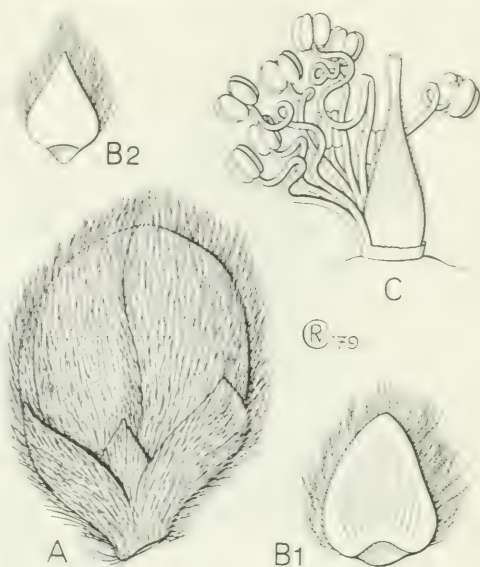


Fig. 115. Flower details in *Shorea* sect. *Ovalis* ASHTON. — *S. ovalis* (KORTH.) BL. A. Bud, B1. outer sepal, B2. inner sepal, C. stamens and pistil, all  $\times 10$  (SAN 19266).

(Kutei), *kontoi*, *k. burong* (W. Borneo), *merangan*, *m. nasi* (Nunukan), *dangar siak*, *d. burau* (Murut), *pērawan lop* (Iban), etc.

**b. ssp. *velutinata*** ASHTON, Gard. Bull. Sing. 20 (1963) 278.

Differing as follows: *Leaves* 6–11 by 3.5–6 cm, ovate or elliptic; base obtuse or cuneate; nerves stoutly prominent evenly sparsely scabrid pubescent, beneath; margin often narrowly revolute.

Distr. *Malesia*: Malaya (E. Pahang, E. Johore), Sumatra, Borneo.

Ecol. As *ssp. parvifolia* but mainly near the coast.

## 10. Section *Ovalis*

ASHTON, Gard. Bull. Sing. 20 (1963) 268: Man. Dipt. Brun. (1964) 117. — *Shorea*, *Red Meranti* group, *S. ovalis* subgroup. SYM. Mal. For. Rec. 16 (1943) 58. — **Fig. 115.**

*Flower buds* broadly ovoid, obtuse; corolla as in *sect. Rubella*; *stamens* 50–70; filaments very long, filiform, folded in bud; anthers subglobose, with 4 pollen sacs; appendage to connective vestigial; *ovary* and *stylopodium* narrowly conical, densely pubescent; style short. *Stipules*, *bracts* and *bracteoles* subsistent. *Leaf* tertiary nervation scalariform; midrib obscure and depressed above. *Bark surface* deeply V-section fissured. *Wood* as in *sect. Brachypterae*.

Distr. *Malesia*: Sumatra, Malaya, Borneo. Monotypic.



Fig. 116: *Shorea ovalis* (KORTH.) BL. *ssp. ovalis*. *a*. Young inflorescence, *b*. fruit, *c*. nut, all  $\times \frac{1}{2}$  (*a* bb. 20237, *b-c* SAN 16474).

**160. *Shorea ovalis* (KORTH.) BL.** Mus. Bot. Lugd.-Bat. 2 (1852) 33; WALP. Ann. 4 (1857) 338; MIQ. Fl. Ind. Bat. 1, 2 (1859) 503; DC. Prod. 16, 2 (1968) 631. — **Fig. 115–118.**

KEY TO THE SUBSPECIES

1. Leaves oblong-ovate,  $\pm$  bent upwards along the midrib, base obtuse.
2. Twig and nervation and lamina beneath  $\pm$  shortly scabrid pink-brown pubescent  
**a. *ssp. ovalis***
2. Twig and nervation beneath rufous tufted tomentose, lamina beneath glabrous, lustrous  
**b. *ssp. sarawakensis***
1. Leaves oblong-obovate, boat-shaped with the lower surface concave; base cuneate  
**c. *ssp. sericea***

**a. *ssp. ovalis*.** — BURCK, Ann. Jard. Bot. Btzig 6 (1887) 219; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 103; MERR. En. Born. (1921) 406; SYM. Gard. Bull. S. S. 10 (1939) 370; Mal. For. Rec. 16 (1943) 80, f. 37B, 38, 49; BROWNE, For. Trees Sarawak & Brunei (1955) 132; ASHTON, Gard. Bull. Sing. 20 (1963) 274; MEIJER & WOOD, Sabah For. Rec. 5 (1954) 125, f. 1b, pl. 8b. — *Dilleniaceae* ? *nervosa* WALL. Cat. (1832) 6635, *nomen*. — *Vatica ovalis* KORTH. Kruidk. (1841) 73; WALP. Rep. 5 (1845) 127; DC. Prod. 16, 2 (1868) 623. — *Vatica eximia* MIQ. Sum. (1861) 486; DC. Prod. 16, 2 (1868) 623; WALP. Ann. 7 (1868)

378. — *Vatica sublacunosa* MIQ. Sum. (1861) 486, 191; DC. Prod. 16, 2 (1868) 623; WALP. Ann. 7 (1868) 378. — *Hopea aspera* DE VRIESE, Minyak Tengkawang (1861) 28. — *S. eximia* SCHEFF. Nat. Tijds. N. I. 31 (1870) 349; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 218, *incl. var. angustifolia* BURCK; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 121; HEYNE, Nutt. Pl. ed. 2 (1927) 1116; SYM. Gard. Bull. S. S. 7 (1933) 143, pl. 43. — *S. sublacunosa* SCHEFF. Nat. Tijds. N. I. 31 (1870) 350; HEYNE, Nutt. Pl. ed. 2 (1927) 1116. — *S. furfuracea* (non MIQ.) BRANDIS, J. Linn. Soc. Bot. 31 (1895) 98, *p.p.*; SLOOT, *ex* HEYNE, Nutt. Pl. ed. 1, 3 (1917) 299; RIDL. Fl. Mal. Pen. 1 (1922) 232, *p.p.* — **Fig. 116, 117.**

Large tree. Twig, petiole, nervation beneath, leaf undersurface, midrib above, panicle and parts of perianth exposed in bud densely persistently pink-brown scabrid pubescent. *Twig* to 3 mm  $\varnothing$  apically, stout, terete, becoming smooth; stipule scars cuneate, c. 2 mm long, slightly ascending. *Bud* to 8 by 6 mm, ovoid, obtuse. *Stipule* to 13 by 7 mm, ovate, acute, prominently nerved, abruptly constricted at base, subpersistent. *Leaves* to 10–18 by 3–7 cm, oblong or narrowly ovate, attenuate, coriaceous; base obtuse; acumens to 8 mm long, narrow; margin  $\pm$  revolute; nerves (20–)22–25 pairs, dense, prominent beneath, curved, set at 55°–70°; tertiary nerves distinct, scalariform, at 90° to nerves; midrib prominently terete beneath, shallowly depressed above; *petiole* 7–9 mm long. *Panicle* to 18 cm long, terminal or axillary,





Fig. 117. *Shorea ovalis* (KORTH.) BL. *ssp. ovalis*. Shoot of 3 m high sapling,  $\times \frac{1}{2}$  (SAN 19446).

terete; singly or doubly regularly branched, branchlets short, compact, bearing to 8 flowers; *bracteoles* to 8 by 6 mm, broadly elliptic, obtuse, tightly cupped round the buds, pink-brown pubescent outside, glabrous within, falling at anthesis. *Flower bud* to 5 mm long, broadly ovoid to globose. *Calyx* densely golden-brown pubescent outside, glabrous within; 3 outer lobes narrowly ovate, acuminate; 2 inner lobes shorter, subacute. *Petals* cream with a pink tinge towards base, ovate, obtuse, densely pubescent on parts exposed in bud. *Stamens* 50–70, of varying lengths, the innermost almost twice as long as the style and almost as long as the petals; filaments filiform, much twisted and folded in bud; anthers elliptic to oblong, the cells rather narrow; appendage to connective short, vestigial. *Ovary* and *stylopodium* narrowly conical, densely shortly pubescent in the distal half, glabrous at base; style short, cylindrical, glabrous. *Fruit calyx* puberulent; 3 longer lobes to 11 by 1.4 cm, spatulate, narrowly obtuse, to 7 mm broad above the to 12 by 9 mm elliptic shallowly saccate slightly thickened base; 2 shorter lobes to 6 by 0.4 cm, linear,

similar at base. *Nut* to 2.2 by 1.3 cm, shortly evenly densely rufous pubescent; style remnant to 2.5 mm long, tapering, acute.

*Distr. Malesia:* Malaya (Penang, E. coast), Singapore, E. Sumatra (Indragiri), Banka, Billiton, Borneo (E. Sabah and Indonesian Borneo).

*Ecol.* Scattered in lowland Mixed Dipterocarp forest, usually in moist places in valleys and low-lying ground, to 500 m.

*Vern.* *Mēranti kepong, kepong labu, k. segar* (Malaya), *mēranti mērah, m. sabut* (Sumatra), *lampong, l. rasa, l. mērambung* (E. Borneo), *damar salēmsung, d. putang, mēsēlurang* (S.E. Borneo), *sēbong gunung putēh* (E. Kutei), *tahan lētup* (Lower Dayak).

**b. *ssp. sarawakensis* ASHTON**, Gard. Bull. Sing. 20 (1963) 275; Man. Dipt. Brun. (1964) 202, f. 19; *ibid.* Suppl. (1968) 111.

*Defining characters:* Twigs prominently rufous tufted tomentose, tufts to 3 mm long; leaf nervation beneath, petiole and panicle shortly sparsely so:



Fig. 118. *Shorea ovalis* (KORTH.) BL. Forest relict tree in Trengganu (Photogr. CORNER, 1935).



lamina beneath glabrous, lustrous. *Leaves* 12–17 by 2–4.5 cm, narrowly oblong, margin prominently revolute, base obtuse, nerves at 55°–65°.

Distr. *Malesia*: Borneo (Sarawak and W. Sabah).

Ecol. As *ssp. ovalis*.

**c. *ssp. sericea*** (DYER) ASHTON, Gard. Bull. Sing. 20 (1963) 255. — *S. sericea* DYER, Fl. Br. Ind. 1 (1874) 306; KING, J. R. As. Soc. Beng. Sc. 62, 2 (1893) 111; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 101, *p.p.*; BRANDIS & GILG in E. & P. Pl. Fam. ed. 1, 3, 6 (1895) 267; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 58; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 308; BURK. J. Str. Br. R. As. Soc. 81 (1920) 73, fig.; FOXW. Mal. For. Rec. 1 (1921) 80; MERR. En. Born. (1921) 406; RIDL. Fl. Mal. Pen. 1 (1932) 223; HEYNE, Nutt. Pl. ed. 2 (1927) 1116; FOXW. Mal. For. Rec. 3 (1927) 33; SLOOT. in Merr. Pl. Elm. Born. (1929) 204; FOXW. Mal. For. Rec. 8 (1930) 23; EDWARDS, Mal. For. Rec. 9 (1931) 147; FOXW. *ibid.* 10 (1932) 229; BURK. Dict. (1935) 2022. — *S. fusca* BURCK, Ann. Jard. Bot. Btzig 6 (1887) 207; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 83. — *S. rigida* BRANDIS in Hook. f. Ic. Pl. (1895) t. 2402; J. Linn. Soc. Bot. 31 (1895) 102; RIDL. Agr. Bull. Str. & F.M.S. 1 (1901) 58; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 306; BURK. J. Str. Br. R. As. Soc. 76 (1917) 164, fig.; *ibid.* 81 (1920) 73; RIDL. Fl. Mal. Pen. 1 (1922) 223; HEYNE, Nutt. Pl. ed. 2 (1927) 1124; FOXW. Mal. For. Rec. 3 (1927) 33.

Defining characters: Twigs and leaves beneath  $\pm$  shortly evenly pink-brown pubescent. *Leaves* 14–22 by 4–10 cm, broadly oblong or obovate, deeply boat-shaped with the lower surface concave, base cuneate, nerves at 50°–55°.

Distr. *Malesia*: Malaya, S. Sumatra (Angkola, Bangkinang and Djambi southwards), Banka, Billiton.

Ecol. As *ssp. ovalis*.

Vern. As *ssp. ovalis*; also *kujung*, *kalup*, *kĕlung daum* (Sumatra).

Note. This subspecies is known to be tetraploid and to reproduce largely apomictically through adventive polyembryony (KAUR *c.s.*, Nature 271, 1978, 440).

#### Insufficiently known

Flowers are unknown from the following three species which can therefore not be placed in a section with certainty.

**161. *Shorea carapae*** ASHTON, Gard. Bull. Sing. 22 (1967) 294, pl. 39; Man. Dipt. Brun. Suppl. (1968) 105, f. 13.

Medium-sized tree with pale flaky bark. Twig, leaf bud, stipule and petiole persistently densely evenly buff sericeous, nervation and midrib above sparsely so. *Twig c.* 3 by 2 mm  $\varnothing$  apically, compressed, drying rugose at first, becoming terete, smooth; stipule scar prominent, almost amplexicaul. *Bud c.* 7 by 2 mm, lanceolate, acute. *Stipule* to 25 by 20 mm, oblong-lanceolate, subacute, caducous. *Leaves* 14–18 by 7–10

cm, broadly ovate, elliptic, coriaceous; base obtuse to cordate; acumen short, broad; nerves 11–13 pairs, stout, prominent beneath, at 50°–70°; tertiary nerves slender, densely scalariform, unraised; midrib appanate to somewhat depressed above, prominent beneath; *petiole* 23–35 mm long, terete. *Flowers* unknown. *Panicle* to 15 cm long, terminal or axillary, terete, smooth or rugulose, densely shortly evenly pale buff pubescent, singly branched; bracteoles to 16 by 5 mm, lanceolate, acute, densely pubescent outside, sparsely so within. *Fruit calyx* and *pedicel* sparsely evenly buff pubescent. *Pedicel* short, stout. 3 longer calyx lobes to 7 by 1.5 cm, spatulate, subacute, *c.* 5 mm broad above the to 6 by 5 mm ovate saccate thickened base; 2 shorter lobes to 25 by 3 mm, linear, similar at base. *Nut* to 10 by 7 mm, ovoid, glabrous, acute.

Distr. *Malesia*: Borneo (Central Sarawak, W. Kutei).

Ecol. Volcanic plateaux at 800–1200 m; locally abundant.

Vern. *Awang jangut* (Kutei), *abang uloh* (Kenyah).

Note. Bark and wood characters suggest that this species belongs to *sect. Brachypterae*.

**162. *Shorea furfuracea*** MIQ. Sum. (1861) 488, 191; WALP. Ann. 7 (1868) 379; BURCK, Ann. Jard. Bot. Btzig 6 (1887) 219; BRANDIS, J. Linn. Soc. Bot. 31 (1895) 98, *p.p.*; HEYNE, Nutt. Pl. ed. 1, 3 (1917) 299. — *S. purpurea* DC. Prod. 16, 2 (1868) 632, *sphalm*.

Medium-sized or large tree, up to 50 m. Twigs, buds, stipules, petioles, leaves beneath and midrib above densely persistently pale chocolate-brown scabrid pubescent. *Twigs c.* 2 mm  $\varnothing$  apically, much branched, terete, becoming smooth. *Buds* to 3 by 2 mm, ovoid, acute. *Stipules* to 6 by 4 mm, ovate, acute, fugaceous. *Leaves* 6–13 by 2.5–6 cm, ovate-oblong, thinly coriaceous; base obtuse; apex shortly acuminate (more prominently so in young trees); nerves 14–17 pairs, slender but prominent beneath, obscurely depressed above, at 65°–75°, with short intermediate secondaries in young trees; tertiary nerves densely scabridiform, distinct and elevated beneath; midrib prominent beneath, evident but  $\pm$  depressed above; *petiole* 9–14 mm long, rather slender. *Flower* and *fruit* unknown.

Distr. *Malesia*: Sumatra (Atjeh, Ophir, Sibolga; P. Musala).

Ecol. Mixed primary forest, up to 400 m.

Vern. *Mĕranti tĕrutung*, P. Musala, *m. udang*, *m. bunga*, Sibolga, *habung banio*, *suantan hambang*, Sum. W. coast, *kĕtrahan silang*, Atjeh.

Note. There are similarities in leaves and buds with *S. dasyphylla* and *S. rugosa* of *sect. Mutica*, but also with *S. scaberrima* of *sect. Brachypterae*.

**163. *Shorea pallidifolia*** ASHTON, Gard. Bull. Sing. 22 (1967) 296, pl. 41; Man. Dipt. Brun. Suppl. (1968) 113, f. 14.

Small to medium-sized tree with V-section fissured bark. Twigs, buds, stipule, petiole and nervation

beneath persistently pale yellowish brown scabrid pubescent, lamina beneath very shortly densely persistently ocherous scabrid pubescent. *Twig* c. 6 by 3 mm  $\varnothing$  towards apex, stout, compressed and ribbed at first, becoming terete; stipule scars c. 2 mm long, horizontal, prominent. *Bud* to 10 by 8 mm, broadly ovoid-conical, compressed. *Stipule* to 7 by 5 mm, oblong, obtuse. *Leaves* 13–22 by 7–13 cm, broadly oblong to ovate or obovate, thickly coriaceous; base obtuse or subcordate; acumen short; nerves 12–19 pairs, obscure above, prominent beneath, arched, at  $110^\circ$  at the base,  $45^\circ$ – $70^\circ$  near the apex; tertiary nerves slender, hardly elevated, densely scalariform; midrib obscure and depressed above, prominent beneath; *petiole* 2–3.5 cm long, stout, drying rugose. *Panicle* to 15 cm long, compressed and prominently angled, axillary, rarely terminal; singly or doubly branched, branchlets to 3 cm long, bearing to 6 distichous flowers; bracteoles to 4 by 3 mm, elliptic, obtuse, shortly evenly pubescent outside, glabrous within, caducous. *Flower bud* to 6 by 3 mm, ellipsoid. *Sepals* pubescent on parts exposed in bud; outer 3 deltoid, acute, inner 2 ovate, smaller and thinner at margin than outer 3. *Petals* elliptic, pubescent on parts exposed in bud; outer 3 deltoid, acute, inner 2 ovate, smaller and thinner at margin than outer 3. *Stamens* unknown. *Ovary* ovoid, glabrous; style filiform, glabrous, somewhat longer than ovary. *Fruit pedicel* and *calyx* shortly sparsely evenly pubescent. *Pedicel* c. 1 mm long and  $\varnothing$ , small. 3 longer calyx lobes to 7 by 1.5 cm, broadly spatulate, obtuse, c. 7 mm broad above the to 10 by 8 mm broadly ovate saccate somewhat thickened base; 2 shorter lobes to 4 by 0.3 cm, linear, similar but smaller at base. *Nut* to 12 by 9 mm, ovoid, shortly apiculate, densely shortly pale buff pubescent.

*Distr. Malesia:* N.W. Borneo (W. and Central Sarawak).

*Ecol.* Rare, on podsols in Heath forest at low altitude.

*Note.* The shape of the ovary, as well as fruit, bark and wood characters, suggested that this species belongs to *sect./subsect. Mutica*.

#### Dubious

*Caryolobis indica* GAERTN. *Fruct.* 1 (1789) 215, t. XLV.

GAERTNER based this genus on a fruit in the Leyden Botanical Institute, said to have come from Ceylon, with the vernacular name *berelie*. It was mostly reduced to the genus *Doona* THW., possibly in part due to the fact that a common name for *Doona* in Ceylon is *beraliya dun*. Unfortunately its type could not be traced in the Leiden carpologica.

The fruit figured seems not to agree with that of *Shorea sect. Doona*, for this is characterized by the extremely unequal cotyledons, one of which is minute and acicular, whereas the picture shows two equal cotyledons. The description is too poor, and in absence of type material unidentifiable in *Dipterocarpaceae*.

#### Excluded

*Cotylelobiopsis beccariana* HEIM, *Rech. Dipt.* (1892) 125; BRANDIS, *J. Linn. Soc. Bot.* 31 (1895) 116; MERR. *En. Born.* (1921) 408; SLOOT. *Bull. Jard. Bot. Btzg III*, 10 (1929) 395.

HEIM based this monotypic genus on a BECCARI specimen consisting of sterile material only, the number of which he did not cite. HEIM annotated many of his types at Kew, but BRANDIS, who conjectured that BECCARI 467 was the type, was clearly unsure from which it may be guessed that this specimen, now lost, was not annotated. The Florence duplicate of this number fits HEIM's description, and represents the fallen leaflets of the *Leguminosae Pseudosindora palustris* SYM. *Proc. Linn. Soc.* 155th sess. (1944) 285; the specimen, mounted with another of the same species numbered 3468, is quoted by DE WIT when he made his new combination *Copaifera palustris* (SYM.) DE WIT (Webbia 9, 1954, 462). HEIM's detailed description of leaf morphology, and especially petiole anatomy, conforms with that of this species and he noted that the latter was atypical of *Dipterocarpaceae*. HEIM's genus and species antedates that of SYMINGTON. Nevertheless the Paris duplicate of BECCARI 467, now also lost, was referred to *Cotylelobium melanoxylon* (Hook. f.) PIERRE by the latter (*Fl. For. Coch.* 3, 1889, t. 235). There must therefore remain some question as to the real identity of the Kew duplicate of BECCARI 467, which anyway cannot with certainty be accepted as the holotype of *Cotylelobiopsis*. Until refound this name must be regarded as doubtful.



# ADDENDA, CORRIGENDA ET EMENDANDA

C. G. G. J. VAN STEENIS, c.s.

At times colleagues have asked me whether my effort to collect the *Addenda, Corrigenda et Emendanda* was worthwhile.

The main purpose is to keep readers up to date with the plants of Malesia in one work and keep them aware of additions, name changes, etc.

They are also important as a source for plant-geographical purposes, to correct names of useful plants, etc.

Another facet of keeping up with the records is that they reflect the degree of completeness of collections at the time of the original revision, and form a certain check on the degree of exploration.

In an overall review of the 'Floristic inventory of the Tropics: Where do we stand?' PRANCE has made use of the Addenda in comparing the state of exploration in the neotropics with that of Africa and Malesia (Ann. Mo. Bot. Gard. 64, 1977, 657–685, especially p. 671). He found the number of addenda and novelties much larger in the neotropics than in Malesia, obviously due to a lower, and especially less varied exploration (collecting density). This comparison tends to support my conviction that the bulk of the Malesian species has become gradually represented in the herbarium.

It was pleasant to experience that the careful keeping on record of the Addenda serves good purposes and should therefore be continued.

Printing errors have only been corrected if they might give rise to confusion.

Volume and page number are separated by a colon. Page numbers provided with either *a* or *b* denote the left and right columns of a page respectively.

## Alismataceae

- 5: 319, 320a *Caldesia parnassifolia* (BASSI ex L.) PARL.  
In Malesia a very rare plant (see map in Fl. Males. I, 5: 322, fig. 3). In New Guinea it was only known from Cape Vogel Peninsula, but it is now also collected in West New Guinea: Star Mts, Sibil Valley, 1200–1300 m (KALKMAN 4188) and in Papua New Guinea: Kubor Ra., Nona Minj Divide, 1920 m (VINK 16512); Morobe Distr., 15 miles west of Lae, 150 m (HARTLEY 9778) and near Mumeng, 950 m (W. Moi 166). In the last-named collection the inflorescence consists of only one whorl of 3 flowers and a terminal flower.

## Anacardiaceae (DING HOU)

- 8: 483 *Spondias pinnata* (L. f.) KURZ.  
KOSTERMANS (Quart. J. Taiwan Mus. 34, 1981, 108–111) suggested that what was named *Spondias pinnata* from Malesia (Malaya to New Guinea) would differ from the typical *S. pinnata* from India and represent an undescribed species, *S. malayana* KOSTERMANS.

When writing the paper he could only rely on his memory of former experience and on only three specimens from Malaya. I observed that in one of them the leaf difference mentioned in his key does not fit. His experience can only relate to the size of trees and bears no testimony on the flower details mentioned in the key and their geographical variability, which is in this genus difficult to judge because of the cultivation, domestication, and running wild of cultivated trees. For the present his delimitation does not seem convincing, especially as there are also discrepancies in his key and descriptions.

## Araliaceae

- 9: 39a *Osmoxylon lineare* (MERR.) PHILIPSON.  
Substitute in description after 'the central branch 4–5 mm long': bearing an umbel of c. 12 sterile, globose, bacciform flowers, c. 8 mm ø when dry.

Distr. Add: Negros Occidental (PANCHO 1845).

Ecol. Low bushy shrub along riverbanks. Flowers orange; fruit dark purple or black. Cultivated (recently) as an ornamental for its dark green and shiny foliage.

Vern. *Miagos*

- 9: 67 *Arthrophyllum stonei* AH-LAN LIM, Mal. For. 43 (1980) 263, f. 1; STONE, Fed. Mus. J. n.s. 26 (1) (1981) 71, f. ii.

Distr. *Malesia*: Malaya: Pahang-Selangor (STONE 12358, 13754, 14140, KLU 27353, 30006, 30007).

Ecol. Montane forest, 1000–1800 m, sometimes dwarfed in elfin forest on summit ridges.

Notes. Said to be intermediate between *A. montanum* and *A. alternifolium*, distinct from the latter by the purple fruit, degree of branching of the inflorescence, and the narrow, thin-coriaceous leaflets.

*A. montanum* and *A. alternifolium* were already distinguished by PHILIPSON (Fl. Males. I, 9: 55) by weak characters and the addition of a third one, with intermediate leaf characters is therefore hardly welcome; the differentiating characters are also slight. Mr. LIM should have given a clear key for the three species instead of this haphazard description.

Prof. PHILIPSON (*in litt.*) finds '*A. stonei*' represents rather larger than usual specimens of *A. alternifolium*.

- 9: 103 Replace: 16. **ELEUTHEROCOCCUS**  
MAXIM. Mém. Ac. Sc. St. Pétersb. Sav. Etr.

9 (1859) 132; S. Y. HU, J. Arn. Arb. 6 (1980) 108. — *Panax* subg. *Acanthopanax* DECNE & PLANCH. Rev. Hort. IV, 3 (1854) 105. — *Acanthopanax* (DECNE & PLANCH.) H. WITTE, Ann. Hort. Bot. 4 (1861) 89; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 10; PHILIPSON, Fl. Males. I, 9 (1979) 103.

Note. Unfortunately *Acanthopanax* has to give way. The two Malesian species should be called:

1. *Eleutherococcus trifolius* (L.) S. Y. HU, J. Arn. Arb. 61 (1980) 110. — *Acanthopanax trifolius* (L.) VOSS. Vilmor. Blumengärtn. 1 (1894) 406; MERR. Philip. J. Sc. 1 (1906) Suppl. 217; PHILIPSON, Fl. Males. I, 9 (1979) 103.

2. *Eleutherococcus malayanus* (M. R. HENDERSON) STONE, Mal. For. 43 (1980) 395. — *Acanthopanax malayanus* M. R. HENDERSON, Gard. Bull. S. S. 7 (1933) 105, pl. 22; PHILIPSON, Fl. Males. I, 9 (1979) 103.

#### Balanophoraceae

##### 7: 797a *Balanophora elongata* BL.

Add to literature: B. C. STONE, Mal. Nat. J. 33 (1979) 129, fig.; Fed. Mus. J. n.s. 26 (1) (1981) 72. — *B. papuana* (non SCHLTR) SOEPADMO, Nature Malaysiana 3 (1) (1978) 24, with col. illus. — *B. hansenii* HAMBALL, Reinwardtia 9 (1980) 425.

##### 7: 798a Add to Distr.: Malaya: Selangor/Pahang border, G. Ulu Kali, in dwarf forest on ridge at 1500–1700 m, on *Pentaphylax auryoides*.

Add to Note: According to Dr. B. HANSEN (*in litt.*) the new record from Malaya belongs undoubtedly to *B. elongata* to which it keys out without difficulty in the key in Fl. Males. I, 7: 793.

##### 7: 802b *Balanophora abbreviata* BL.

Add to Distr.: New Hebrides: Mallicolo I. (N. HALLÉ RSNH 6351), parasitic on *Ficus*. Cf. HALLÉ, Adansonia 17 (1978) 260.

Add to Note: Mr. G. D. AREKAL & G. R. SHIVAMURTHY (Phytomorph. 26, 1976, 135–138, 6 fig.) have, for the first time, been able to examine, *in situ* – since all former experimental infections have failed – the germination of the seed of *B. abbreviata*, a magnificent achievement with these utterly minute seeds. After the breaking of the seed coat the endosperm cells produce 4–8 narrow tubular extensions coated with a sticky substance adhering to the fine rootlets for anchorage. Then the hardly differentiated embryo produces 1–4 tubular processes to form the primary haustorium, penetrating into the rootlet and making contact with the vascular tissue of the rootlet of the host; a nodule develops, throwing off the seed coat, and parasitism

is established. The procedure is established on uninjured rootlets. Naturally it does not exclude the possibility that infection can also proceed on injured roots or even stem bases of host plants.

#### Bignoniaceae

##### 8: 137b *Deplanchea bancana* (SCHEFFER) STEEN.

Add to Distr.: Central Celebes (Baolu, near Palopo; Usu near Malili; near Matana lake).

Add to Notes: The Celebes specimens were poor and originally assigned to *D. glabra* (STEEN.) STEEN. With abundant recent adequate material from localities nearby, they appear to belong to *D. bancana*.

##### 8: 138a Change in Fig. 11, map: the localities from Celebes of *Deplanchea glabra* belong to *D. bancana*.

##### 8: 141a *Deplanchea glabra* (STEEN.) STEEN.

Delete Celebes from the distribution.

##### 8: 148b 3. *Stereospermum colais* (HAM. ex DILLW.) MABBERLEY, Taxon 27 (1978; publ. 1979) 553. — *Bignonia colais* HAM. ex DILLW. Review of the references to the Hortus Malabaricus etc. (1839) 28, based on padri RHEEDE, Hort. Malab. 6, t. 26. — *S. personatum* (HASSK.) CHATTERJEE; STEEN. Fl. Males. I, 8 (1977) 148.

Nomencl.: On the strength of HAMILTON's opinion that this was different from *Bignonia chelonoides* L. f., DILLWUN proposed a new name, which antedates that of HASSKARL.

##### 8: 159a, *Fernandoa macroloba* (MIQ.) STEEN.

153b The mention of this N. Sumatran endemic tree (as '*Heterophragma macrolobium*' = *Haplophragma macrolobum* (MIQ.) STEEN.) by FIENLEY & RICHARDS (eds.), The Krakatau Centenary Expedition, in Dept. Geogr., Univ. Hull, Misc. ser. 25 (1982) 16, 27, 48, 166 is derived from a misidentification; the specimens belong to the common *Radermachera glandulosa* (BL.) MIQ.

##### 8: 160, 161 These two pages have unfortunately become transposed.

##### 8: 177a *Pandorea pandorana* (ANDR.) STEEN.

Add to Distr.: Central Celebes (VAN BALGOOY 3915), and change Fig. 38, map, accordingly.

#### Burmanniaceae

##### 4: 20, *Gymnosiphon* BL.

593a Add to Distr.: Lesser Sunda Islands: Flores (SCHMUTZ 4802, prob. *G. aphyllus* BL.). The genus is not yet reported from the Moluccas and the Philippines.

##### 4: 21 *Thismia* GRIFFITH.

Add the synonym: *Geomitra* BECC. Malesia



1 (1877) 250.

Add Note. 15. *Thismia clavigera* seems to be better accommodated in *Thismia* sect. *Sarcosiphon* (BL.) JONKER, from the three species of which it is distinct by the free clavate inner tepals.

- 4: 22 Insert in the key after the second lead of 1:  
1a. Inner perianth lobes connate at the tips, forming an erect mitre with large holes. Continue to 12.

1a. Inner perianth lobes connate at the tips, forming a mitre with large holes, the lobes continued above the mitre as 3 free, almost erect, filiform, clavate segments . . . . . 15. *T. clavigera*

- 4: 25 Insert after 14. *Thismia crocea*:  
15. *Thismia clavigera* (BECC.) F.v.M. Vict. Nat. (1890) 235; Pap. & Proc. R. Soc. Tasm. for 1890 (1891) 235; STONE, Blumea 26 (1980) 420, pl. — *Geomitra clavigera* BECC. Malesia 1 (1877) 250, t. 10, f. 1; Jonker, Fl. Males. I, 4 (1948) 25. — Fig. 1.



Fig. 1. *Thismia clavigera* (BECC.) F.v.M.,  $\times 2$  (after BECCARI).

Distr. *Malesia*: Malay Peninsula (?Perak, G. Hiau above Taiping; Langkawi Is.), N. Sumatra (Gajo Lands), Borneo (Sarawak: Lundu Distr.).

- 4: 25 Delete 4. *Geomitra* etc.

#### Burseraceae (LEENHOUTS)

- 5: 222a *Dacryodes rugosa* (BL.) H. J. LAM.  
Add to Distr.: Nicobar Is., Katchal I. (var. *rugosa*).

- 5: 228b *Dacryodes longifolia* (KING) H. J. LAM.  
Add to literature: KOCHUMMEN in Whitmore, Tree Fl. Malaya 1 (1972) 141.  
Add to description: Tree up to 40 m with buttresses up to 3.5 m (cf. KOCHUMMEN, 1972).

Add to Distr.: Throughout the Malay Peninsula (KOCHUMMEN, 1972); var. *longifolia* also in Borneo.

Insert: Ecol. Usually on coastal hills or hills which were coastal in the Pleistocene (KOCHUMMEN, 1972), up to 300 m. Fr. April.

- 5: 232a *Santiria grandiflora* KALKMAN.  
Add to description: Branchlets up to 1.75 cm thick. Leaflets finally glabrous beneath. Fruits nearly transversely obovate, 2 by 1.25 by 1.5 cm, stigma more than 90° excentric.

Add to Distr.: N. Borneo (Sipitang Distr., Mendalong, Lumaku For. Res.).

- 5: 251 Add in the key to the species of *Canarium*, after the second lead of 6:

6b. Stipules up to 1.5, rarely 2.5 cm long, not distinctly exceeding the terminal bud. Branchlets solid. Stamens 6.

7a. Branchlets 1.5–3 cm  $\phi$ ; pith thick and soft.

7A. Petiole terete with the stipules inserted at the base. Fruit glabrous

#### 56. *C. batjanense*

7A. Petiole sharp-angular with the stipules inserted on the angles up to 5 cm from the base. Fruit prickly-hairy . . . . . 43. *C. hirsutum*

- 5: 275a *Canarium grandifolium* (RIDL.) H. J. LAM.  
Add to Distr.: According to KOCHUMMEN (in Whitmore, Tree Fl. Malaya 1, 1972, 129) also in Borneo (Brunei).

- 5: 276b *Canarium decumanum* GAERTN.  
Add to description: Leaflets of the upper pairs sometimes on the basiscopic side decurrent till the rachis. Fruits up to 12 cm long.

Add to Distr.: Admiralty Is. (Manus I.).  
Add to Ecol.: sago swamp.

- 5: 283b *Canarium fusco-calcynum* RIDL.  
Add to description: Tree up to 21 m high and 60 cm  $\phi$ . Infructescences c. 15–30 cm long with few short oblique-erect branches and with few fruits; calyx funnel-shaped,

trigonus, c. 1 cm diam. Fruits (immature) narrowly oblong, tapering to both ends, trigonous in section, 3.5 by 1.25 cm, glabrous; in section the kernel with flat sides and slightly rounded angles, the lids with a very faint median rib, lids c. 1.5 mm thick. Seeds 2, the sterile cell moderately reduced.

Add to Ecol.: On clay, up to 340 m. *Fl.* Aug.

- 5: 290a *Canarium rigidum* (BL.) MIQ.  
Add to Distr.: Moluccas (Obi I.).

- 5: 290b, *Canarium cestracion* LEENH.  
291a Add to description: Twigs up to 11 mm ø. Stipules linear, tapering to an acute point, 4 by 1 mm. Leaves up to 8-jugate; leaflets from 2.5 cm broad on; acumen sometimes long and slender; nerves up to 17 pairs. Fruits up to 3 cm high and 1.75 cm broad. Add to Distr.: Milne Bay Distr.

- 5: 296, Insert after 55. *Canarium pimela*:  
6: 928 56. *Canarium batjanense* LEENH. *Blumea* 27 (1981) 211.

Distr. *Malesia*: Moluccas: Batjan I. (Mt Sibela).

Ecol. Canopy or subcanopy tree in primary forest, 250–1050 m. *Fl.* fr. Oct.

Note. The present species seems to be allied with *C. acutifolium* MERR., *C. balsamiferum* WILLD., and *C. oleosum* ENGL., which is also well in accordance with its geographical position (cf. LEENHOUTS, *Blumea* 9, 1959, 317, f. 9). It seems nearest to *C. balsamiferum*, which differs by the absence of stipules, the far stronger reduced pistil in the male flower, and the fruit cells that are all three well developed. The only moderately reduced pistillode is well in accordance with *C. oleosum*, different in both other points mentioned under *C. balsamiferum*, however, and moreover in the much smaller, nearly ovoid fruits. Vegetatively, *C. acutifolium* and *C. batjanense* are hardly separable but for the longer and more persistent stipules of the former; *C. acutifolium* differs, however, in the strongly reduced pistillode and in the smaller and more globular fruits.

- 7: 822a *Dacryodes multijuga* LEENH. Add:

Distr. South Sumatra (FORBES 3073, L), fruits only. Hitherto only known from one collection in Malaya.

### Campanulaceae

- 6: 118 Insert after 4. *Wahlenbergia marginata*:  
5. *Wahlenbergia papuana* v. ROYEN, Bot. J. Linn. Soc. 77 (1978) 121, f. 2.

Branched dwarf herb, prostrate. Twigs, leaves and calyx hairy. Leaves at end of twiglets, narrow-oblongate, 8–10 mm long. Filaments glabrous, not widened at base, thus different from both *W. confusa*

and *W. marginata*.

Distr. *Malesia*: Papua New Guinea: along bank leading from Iswan swamp to Koma Creek (Mt Victoria), c. 2650 m. *Fl.* fr. May.

Note. According to the author closely related to the glabrous New Zealand species *W. albomarginata* Hook. f.

- 6: 122, P. VAN ROYEN has provided a new key to  
928 the New Guinea species of *Lobelia*. Cf. Bot. J. Linn. Soc. 77 (1978) 120.

- 6: 136, Add to the species of *Lobelia*:  
928 *Lobelia victoriensis* v. ROYEN, Bot. J. Linn. Soc. 77 (1978) 118, f. 1.

Stemless dwarf, 7–20 mm high, with a single central flower in a rosette of ovate leaves. Corolla isomorous, without a dorsal slit, lobes 5, equal, filiform, long.

Distr. *Malesia*: Papua New Guinea: Iswan swamp on Mt Victoria, 2660 m alt. *Fl.* fr. May.

### Caprifoliaceae

- 4: 175 Add to the family description: Leaves very rarely scattered or in pseudowhorls (*subfam. Alseuosmoideae*).

- 4: 176 Insert in the key after the second lead of 1:  
1a. Leaves scattered or in pseudowhorls

#### 5. Periomphale

1a. Leaves decussate. Continue to 2.

- 4: 191a *Sambucus javanica* BL.  
Add to literature: STEEN. *Blumea* 24 (1978) 479.

- 4: 192a Add to Distr.: West New Guinea: Arfak Mts, Mt Lensemö, 1850 m, BW 12657; Wissel Lake region, EYMA 4618; Papua New Guinea: Morobe Distr., Sattelberg, Timbe R., 1500 m, CLEMENS 7793.

Add to Notes: These records fill the gap of the generic range in East Malesia, two species being recorded from Australia, which are discussed in VAN STEENIS, l.c.

- 4: 194 Insert after 4. *Carlemannia*:

#### 5. PERIOMPHALE

BAILL. Bull. Mens. Soc. Linn. Paris 1 (1888) 731; STEEN. *Blumea* 24 (1978) 480. — *Pachydiscus* GILG & SCHLTR, Bot. Jahrb. 39 (1906) 270. — *Memecyanthes* GILG & SCHLTR, l.c. 269.

Shrublets. Leaves scattered or in pseudowhorls, entire or with a few faint teeth towards the apex. Flowers actinomorphic, 5-merous, fascicled or solitary axillary. Ovary inferior, 2-celled, with rather few (1–4) ovules on the septum. Corolla gamophyllous, somewhat barrel-shaped. Stamens 5, free.

Distr. New Caledonia (4 spp.), Papua New Guinea (1 sp.).

Notes. This genus belongs to the subfamily *Alseuosmoideae*, best known from



the small genus *Alseuosmia* A. CUNN. from New Zealand.

There is no unanimity of opinion about its taxonomic place. Sometimes it is treated as a separate family, but mostly it is assigned an isolated place in *Caprifoliaceae*, to which I agree. This is another New Caledonian genus now turned up in New Guinea. A third, yet undescribed monotypic genus of the subfamily occurs in Queensland (VAN STEENIS, *l.c.*).

**1. *Periomphale papuana* STEEN.** *Blumea* 24 (1978) 481.

Glabrous, epiphytic shrublet, *c.* 75 cm; stem and branches very slender. *Leaves* scattered and in pseudowhorls, lanceolate-oblong, 15–25 by 6–8 mm, cuneate at base, acute at apex, margin entire or mostly with 1 or 2 short gland-tipped teeth; nerves 2–3 pairs; very erect; venation impressed above. Petiole 3–4 mm. *Flowers* solitary; pedicels pink, 1–2 mm. *Calyx lobes* 5, thickish, blunt-deltoid, 1.25 by 0.5 mm. *Corolla* narrowly barrel-shaped, 6 mm long, pinkish light green; lobes 1 mm, carunculate inside apex. *Stamens* 5, free, alternipetalous. *Ovules* 4–5 in each cell, attached to the septum, flattish. Style columnar, as long as the corolla; stigma globular, rugose.

*Distr. Malesia:* Papua New Guinea: West Sepik Distr., Telefomin Subdistr., 3000 m alt., in *Podocarpus-Phyllocladus* woodland with *Gahnia* tussocks dominating the undergrowth (LAE 670687).

**Celastraceae (DING HOU)**

6: 233 *Celastrus hindsii* BTH. Cf. STONE, Mal. For. 43 (1980) 244.

This species was not treated in the paper, but its occurrence in Malaya is mentioned twice in the summary. The specimen in question (STONE 14039) was misidentified and belongs to the common *C. monospermoides* LOES.

6: 243 *Xylonymus* KALKMAN.  
Change in description: Flowers 4–5-merous.

6: 245 *Xylonymus versteeghii* KALKMAN.  
Add to *Distr.*: West New Guinea: Dalman, Nabire, KANEHIRA & HATUSIMA 12241; Darmi Distr., BW 9317. Moluccas: Obi I., DE VOGEL 4347.

6: 420 *Salacia kalahiensis* KORTH.  
Hitherto known from the Philippines, Borneo and Java. Now also from the Lesser Sunda Is.: W. Flores (Paku, 400 m, SCHMUTZ 4523; vern.: *wase mantur*).

**Chenopodiaceae**

4: 104 *Arthrocnemum* MOQ.

After a long and careful study of Australian *Salicornieae* P. G. WILSON has concluded that the concept of the genus *Arthrocnemum* is polymorphous, and that the Malaysian species attributed to it (*A. indicum*) should belong to a new genus, *Halosarcia*, differing from *Arthrocnemum* in sclereids and the adaxial stamen which he finds of fundamental importance; he suggested that the two genera are not closely related.

Within *Halosarcia indica* WILSON distinguishes four subspecies, two of which are endemic to Australia and two others occur also outside Australia, the type *ssp. indica* also in India and Tanzania, and a new subspecies in South Malesia.

As *ssp. indica* might also be found in Malesia, I extract WILSON's key.

***Halosarcia indica* (WILLD.) P. G. WILSON**, *Nuytsia* 3 (1980) 63. — *Arthrocnemum indicum* (WILLD.) MOQ.: BACKER, Fl. Males. 1, 4 (1949) 104.

KEY TO THE SUBSPECIES

1. Plant decumbent or prostrate. Articles of branches corky with age, ± truncate, entire . . . . . *ssp. indica*
1. Plant ± erect. Cortical tissue of articles shrivelling with age, often lobed, ± ciliolate . . . . . *ssp. leiostachya*

*ssp. leiostachya* (BTH.) P. G. WILSON, *Nuytsia* 3 (1980) 66. — *Arthrocnemum ciliolatum* BUNGE ex UNG.-STERNB. Versuch Syst. Salicornieen 69 (1866); UNG.-STERNB. D. Atti Congr. Int. Bot. Firenze 1874 (1876) 283, based on specimens from Java and Lesser Sunda Is.; A. J. SCOTT, Bot. J. Linn. Soc. 75 (1977) 370. — *Salicornia leiostachya* BTH. Fl. Austr. 5 (1870) 203. — *Arthrocnemum leiostachya* (BTH.) PAULSEN, Dansk Bot. Ark. 2 (8) (1918) 61.

*Distr. Australia, South Malesia:* north-coast of Java, incl. Madura and Kangean Is., Lesser Sunda Is. (Sumba, Sumbawa, Timor).

**Connaraceae (LEENHOUTS)**

- 5: 495 Anatomy. W. C. DICKISON (J. Elisha Mitchell Sc. Soc. 87, 1971, 77–86; *ibid.* 88, 1972, 120–136; *ibid.* 89, 1973, 121–138) concluded that *Connaraceae* are distinctly allied with *Leguminosae* and *Rosaceae*. His conclusions regarding relationships within the family deserve a more critical attitude, however, as at that time the author was in-

sufficiently aware of the difficulties of interpreting taxonomy, especially regarding synonymy; he was too much inclined to take identifications of herbarium specimens for granted.

Palynology. W. C. DICKISON, Pollen et Spores 21 (1979) 31–79. In this extensive survey of the pollen of the *Connaraceae*, the author avoided the mistakes made in his earlier anatomical papers. This makes his conclusions of greater importance. The taxonomic opinions brought forward in the Flora Malesiana revision of this family are to a high degree confirmed.

- 5: 504a *Aglaea trinervis* (LLANOS) MERR.  
Add to Distr.: Hainan (cf. ANON., Fl. Hainan 3, 1974, 113).

- 5: 507b *Roureopsis asplenifolia* SCHELLENB.  
Add to Distr.: Borneo.

- 5: 520a *Rourea prainiana* TALBOT.  
Add to Distr.: Northern Thailand (cf. VIDAL, Fl. Thailand 2, 1972, 124).

- 5: 524b *Ellipanthus beccarii* PIERRE.  
Add to Distr.: Sumatra (var. *beccarii*).

- 5: 526 Correct the key to the species of *Connarus* as follows:  
second lead of 18: . . . . . endocarp sparsely to densely non-glandular pubescent.  
couplet 19: delete 'Sepals blunt' versus 'Sepals acute'.

- 5: 528 Insert after 2. *Connarus euphlebius*:  
2a. *Connarus impressinervis* STONE, Mal. For. 43 (1980) 255, fig.

Differs from *C. euphlebius* MERR. as follows: Branches and leaves glabrous. Petioles 0.8 cm. Nerves 5–6(–8) pairs. Petals (under the fruit) outside appressed short-hairy. Beak of fruit faint, lateral, slightly below the apex; pericarp outside glabrous, inside with a few scattered hairs.

Distr. *Malesia*: Borneo (Sarawak; S 14731, S 18903, S 24232, S 24715, S 28417).

Note. Already in 1962 I studied the type material on which this new species is based and found that it is allied to *C. euphlebius*, but differed in several points and seemed to represent a new species. I pointed out the differences cited above (*in sched.*). Because floral characters are important in the genus, I refrained from describing it, all material hitherto known being in fruit.

- 5: 538b *Connarus monocarpus* L. ssp. *malayensis* LEENH.  
Add to Distr.: SE. Thailand (cf. VIDAL, Fl. Thailand 2, 1972, 129).

#### Convolvulaceae

- 4: 485a Change 36. *Ipomoea illustris* etc. as follows:

36. *Ipomoea campanulata* LINNÉ, Sp. Pl. (1753) 160; MOON, Cat. Pl. Ceyl. (1824) 14;

TRIMEN Handb. Fl. Ceyl. 3 (1895) 221; AUSTIN, POWELL & NICOLSON, Brittonia 30 (1978) 196. — *Adamboe* RHEEDE, Hort. Mal. 11 (1692) 115, t. 56 (lectotype). — *I. illustris* (CLARKE) PRAIN, Beng. Pl. 2 (1903) 735; OOSTSTR. Fl. Males. I, 4 (1953) 485.

Note. Apparently *Adamboe* RHEEDE does not belong to *Stictocardia* — as VAN OOSTSTROOM hesitantly assumed — and becomes the type through the new typification. The name change is a nuisance, but has to be accepted.

- 4: 485b Change 37. *Ipomoea crassicaulis* etc. as follows:

37. *Ipomoea carnea* JACQ. ssp. *fistulosa* (MART. ex CHOISY, in DC.) D. AUSTIN, Taxon 26 (1977) 237. — *I. fistulosa* MART. ex CHOISY in DC. Prod. 9 (Jan. 1845) 349. — *Batatas crassicaulis* BTH. Voy. Sulph. 5 (June 1845) 134. — *I. crassicaulis* (BTH.) B. L. ROBINSON, Proc. Am. Ac. Sc. 51 (1916) 530; OOSTSTR. Fl. Males. I, 4 (1953) 485.

Note. AUSTIN has convincingly shown that the differences between *I. carnea* and *I. fistulosa* do not merit specific distinction. As the two forms, which are distinct by minor vegetative characters, grow in South America largely geographically isolated (allopatric), a subspecific rank (as a race) seems the best disposition.

- 4: 487a Change 40. *Ipomoea tuba* etc. as follows:  
40. *Ipomoea macrantha* R. & S. Syst. Veg. 4 (1819) 451; POWELL, NICOLSON & AUSTIN, Brittonia 30 (1978) 201. — *I. tuba* (SCHLECHTEND.) G. DON, Gen. Syst. 4 (1838) 271; OOSTSTR. Fl. Males. I, 4 (1953) 487.

Note. An unfortunate but unavoidable name change of a pantropical species.

#### Crassulaceae (H. OHBA, Tokyo)

- 4: 197 Insert the key and replace the species description under the genus *Sedum* L. by the following new treatment:

#### KEY TO THE SPECIES

1. Sepals free.
2. Flowers 4-merous, sepals narrowly oblong-spathulate. Styles very short (less than 0.3 mm). Flowering stems simple. Cauline leaves spatulate
  1. *S. erythrospermum* ssp. *australe*
2. Flowers 5-merous, sepals spatulate (to oblong). Styles long (0.9–1.2 mm). Flowering stems tri- (rarely bi-)furcate. Cauline leaves spatulate to broadly obovate . . . . . 2. *S. formosanum*
1. Sepals connate for c. 0.5 mm. Flowers 5-merous, sepals linear-lanceolate to very narrowly oblong. Style long (c. 1.2



mm). Flowering stems with a short sterile shoot or simple. Cauline leaves oblanceolate to narrowly obovate

3. *S. parvisepalum* *ssp. philippinense*

1. *Sedum erythrospermum* HAYATA, Ic. Pl. Formos. 3 (1913) 110.

*ssp. australe* MERR. H. OHBA, J. Jap. Bot. 52 (1977) 322. — *S. australe* MERR. Gov. Lab. Publ. Philip. 29 (1905) 16, *non* ROSE (1903); Philip. J. Sc. 5 (1910) Bot. 350, *p.p.*; En. Philip. 2 (1923) 217, *p.p.* — *S. ambiflorum* R. T. CLAUSEN, Cact. Succ. J. 18 (1946) 58; BACKER, Fl. Males. I, 4 (1951) 197, *versim.*, *p.p.* — Fig. 2a–d.



Fig. 2. *Sedum erythrospermum* HAYATA *ssp. australe* H. OHBA. a. Petal with stamen, b. sepal, c. nectar scale, d. ovaries. — *S. parvisepalum* YAMAMOTO *ssp. philippinense* H. OHBA. e. Petal with stamen, f. calyx lobe, g. nectar scale, h. ovaries. All  $\times 5$  (a–d ELMER 6568, e–h MUNI 5644).

Succulent, glabrous, perennial herb. Roots thin. Flowering stems annual, 5–10 cm long, 1.5–2 mm  $\phi$ , simple, erect from nearly decumbent base, smooth. *Leaves* alternate (rarely opposite or ternate), remotely arranged, sessile, shortly spurred (the spur with a round-truncate apex, c. 0.5 mm long), entire, spatulate, apex round or obtuse, base long attenuate, 7–18(–27) by 2–5(–11) mm, thick-herbaceous, flat, smooth, spreading or ascending. *Inflorescences* terminal, a ternate bracteate cyme. Bracts leafy, spatulate to obovate. *Flowers* mostly 4-merous, erect, sessile. *Sepals* free, narrowly oblong-spatulate, base spurred (the spur with round-truncate apex, 0.2 mm long), apex round to nearly truncate, somewhat broadening towards the base, entire, somewhat unequal in size, 2–4 by 0.8–1 mm, more or less fleshy, green, smooth, suberect throughout, persistent at fructescence. *Petals* bright yellow, connate c. 0.3 mm from the base, lanceolate, acuminate, c. 4 mm by 1.2 mm, widely spreading at anthesis. *Stamens* 8, shorter

than the petals, erect at anthesis; filaments filiform, 3–4 mm, oppositipetalous ones c. 1 mm from the base connate with the petal. Nectar-scales flat, narrowly oblong, 0.8 by 0.3 mm. *Gynoecium* 3–4 mm long, the ovaries basally for c. 0.5 mm connate, ventrally gibbose, dorsally round, suberect, 1.5 mm wide at the middle, style very short, less than 0.3 mm. *Ovules* c. 20 in each locule.

*Distr. Malesia:* Philippines (Luzon, Benguet Prov.: Mt Santo Tomas, ELMER 6568 = PNH 114365). The *ssp. erythrospermum* occurs in Formosa.

*Ecol.* On ledges and gravelly hillside near the summit of mountain, 2000–2200 m.

*Note.* *Ssp. erythrospermum* differs from *ssp. australe* in having 5-merous flowers, narrowly oblong-oblancoate or linear sepals, subulate or narrowly lanceolate petals, and usually trifurcate flowering stems.

2. *Sedum formosanum* N. E. BROWN, Gard. Chron. n.s. 24 (1885) 134; FORBES & HEMSLEY, J. Linn. Soc. 26 (1888) 285; HAYATA, Ic. Pl. Formos. 2 (1912) 12; PRAEGER, Not. R. Bot. Gard. Edinb. 13 (1921) 83; J. R. Hort. Soc. 46 (1921) 295; R.-HAMET, Candollea 4 (1929) 32; BERGER in E. & P. Nat. Pfl. Fam. ed. 2, 18a (1930) 460; FRÖD. Act. Hort. Gothob. 6 (1931) app. 97, f. 778–784, t. 62; OHWI, Fl. Jap. Engl. ed. (1965) 497; HATUS. Mem. Fac. Agr. Kagoshima Univ. 5 (1966) 31; Fl. Ryukyus (1971) 301; MORAN in Walker, Fl. Okinawa (1976) 508; H. OHBA, J. Jap. Bot. 52 (1977) 322. — *S. mariae* R.-HAMET in Fedde, Rep. 8 (1910) 143.

Succulent, glabrous, perennial herb, up to 25 cm high. Flowering stems erect from a creeping or procumbent base, once or twice tri- (rarely bi-)furcate, terete, smooth. *Leaves* alternate, remotely arranged, sessile, very shortly spurred (the spur less than 1 mm), entire, spatulate to broadly obovate, apex round, base long-attenuate, 1.5–3.5 by 0.6–1.6 cm, fleshy, bright green above, paler below, smooth. *Inflorescences* terminal, a ternate, bracteate, loosely many-flowered cyme. Bracts leafy. *Flowers* 5-merous, sessile, 6–9 mm at anthesis. *Sepals* free, very shortly spurred (c. 0.3 mm), entire, spatulate or rarely oblong, apex round, somewhat broadening towards the base, nearly equal in size, 2.8–3.7 by 0.8–1.3 mm, fleshy, ascending at anthesis. *Petals* bright yellow, basally connate for c. 0.5 mm, lanceolate to oblong-lanceolate, acute, 5.2–6.2 by 1.3–1.6 mm, nearly erect or ascending at anthesis. *Stamens* 10, shorter than the petal, nearly erect at anthesis; filaments filiform, c. 4.5 mm, the oppositi-

petalous ones for c. 0.8 mm connate with the petal, anthers oblong, c. 0.4 mm long, deep yellow before dehiscence. Nectar-scales broadly oblong-obovate to broadly oblong, c. 0.5 by c. 0.4 mm, creamy white, flattish. *Gynoecium* 5.6–6.2 mm long, the ovaries for c. 1.5 mm connate, ventrally gibbose just above the ventral connection, dorsally round, erect throughout, c. 1.6 mm wide at the middle part, abruptly narrowing near the apex; style 0.9–1.2 mm, slender, tapering towards the apex; stigma lowly papillate, yellowish. *Ovules* 20–24 in each locule. Follicles 6–7 mm long, whitish, obovate, carpels not spreading. *Seeds* oblong, c. 0.7 mm long, testa brown, very minutely punctulate throughout.

Distr. Formosa and Japan (Ryukyu and Kyushu), in *Malesia*: N. Philippines (Batan I.: HATUSIMA & SATO 28624).

Ecol. On rocks at the shore, rarely inland. *Fl.* June–August.

**3. *Sedum parvisepalum* YAMAMOTO, Suppl. Ic. Pl. Formos. 2 (1926) 22, f. 14.**

*ssp. philippinense* H. OHBA, J. Jap. Bot. 52 (1977) 323. — *S. australe* (non MERR.) STEEN. Bull. Jard. Bot. Botz III, 13 (1934) 195. — *S. ambiflorum* (non R. T. CLAUSEN) BACKER, Fl. Males. I, 4 (1951) 197, *p.p.*—Fig. 2e–h.

Succulent, glabrous, perennial herb, up to 15 cm high. Flowering stems ascending or erect from creeping, sometimes branched base, with a short sterile shoot or simple, terete, smooth. *Leaves* alternate, remotely arranged, sessile, very shortly spurred (c. 0.5 mm), entire, narrowly obovate to oblanceolate, apex obtuse, base attenuate, 0.9–1.7 by 4–6 mm, thick-herbaceous, smooth. *Inflorescences* a terminal, ternate cyme, densely 30–50-flowered, sparsely bracteate. Bracts leafy. *Flowers* 5-merous, sessile, c. 10 mm wide at anthesis. *Sepals* basally for c. 0.5 mm connate, linear-lanceolate to very narrowly oblong, entire, slightly unequal in size, 2.5–3.5 by 0.5–0.7 mm, apex round, slightly broadening towards the base, base spurless, fleshy, ascending or spreading through anthesis. *Petals* bright yellow, basally for c. 0.5 mm connate, lanceolate, apex acute to acuminate-acute, 5–6.5 by 0.8–1 mm, spreading at anthesis. *Stamens* shorter than the petals, filaments 3.5–3.7 mm, the opposit-petalous ones for c. 1 mm connate with the petals, anthers ovate, c. 0.6 mm long, reddish before dehiscence. Nectar-scales broadly oblong to square, c. 0.5 by 0.3 mm. *Gynoecium* 4–5 mm long, the ovaries for 0.7 mm connate, ventrally gibbose, dorsally round, c. 1 mm wide, tapering towards the

apex from the middle, style c. 1.2 mm, slender, stigma not papillate. *Ovules* (20–) 24 (–34) in each locule. Follicles brownish, 4–5 by c. 2.5 mm, carpels widely spreading. *Seeds* brownish red, oblong-cylindrical, 0.7 mm long, apex round, testa very minutely punctulate.

Distr. *Malesia*: Philippines (Luzon, Benguet Prov.: BS 4279, 4451, 5373, 5644, MERRILL 4861, VAN STEENIS 17950, WILLIAMS 117). The *ssp. parvisepalum* occurs in Formosa.

Ecol. On rocks or boulders along steep slopes, c. 300–1700 m.

Note. *Ssp. philippinense* is distinguished from the Formosan *ssp. parvisepalum* by the narrowly obovate to oblanceolate leaves, shorter flowering stems, and longer petals. *Ssp. parvisepalum* has linear-oblanceolate leaves, flowering stems up to 25 cm long, and petals attaining 7.5 mm long. *Ssp. philippinense* differs from the Philippine *S. erythrospermum ssp. australe* by the 5-merous flowers, the ovaries with long style, the broadly connate, linear-lanceolate sepals, and the narrowly obovate to oblanceolate cauline leaves.

### Cyperaceae

- 7: 468 Add to Fig. 10, map of *Mapania*: Lesser Sunda Islands: Flores  $\frac{2}{0}$
- 7: 471a *Mapania macrocephala* (GAUDICH.) K. SCH.  
Add to Distr.: Lesser Sunda Is. (W. Flores: Paku, Wae Meleng, 700 m, damp stream-bed in rain-forest, SCHMUTZ 4913).  
Add to Notes: The species was known from the S. Philippines and N.–Central Moluccas eastwards; Flores is an important extension westwards. The nuts are on the small side, some 4–4.5 by 3 mm and pearl grey.
- 7: 474a *Mapania cuspidata* (MIQ.) UITTEN.  
Add to Distr.: Lesser Sunda Is. (W. Flores: Paku, 500 m, plant 1 m, locally gregarious, in rain-forest, SCHMUTZ 4816).  
Add to Notes: The widest distributed species of the genus, of which KERN (Fl. Males. I, 7, 1974, 466) expressly stated that it lacked in the Lesser Sunda Islands, the gap now being filled.
- 7: 522a *Lipocarpa chinensis* (OSB.) KERN.  
Add to Distr.: Lesser Sunda Is. (Flores: VELDkamp 7102).
- 7: 567a *Fimbristylis eragrostis* (NEES) HANCE.  
Add to literature: VELDkamp, Reinwardtia 10 (1982) 26.  
Add to Distr.: Australia: Northern Territory (Arnhem Land: P. K. LATZ 2836).
- 5: 567b *Fimbristylis fusca* (NEES) CLARKE.  
Add to literature: VELDkamp, Reinwardtia 10 (1982) 26.



- Add to Distr.: Australia, Northern Territory (Katherine Gorge: DUNLOP 3733). A new record for Australia.
- 7: 605b *Cyperus esculentus* LINNÉ.  
Add to literature: EVERAARTS, Weeds Vegetables Java (1981) 79. KERN knew this widely distributed species only from a single 'suspected' collection. This suspicion is now removed by Mr. A. P. EVERAARTS in his study on weeds of Java. He collected this species in fields (with vegetables) near Lembang and Pengalengan in West Java and on Mt Tengger (Tosari, Ngadisari) in East Java at 1300–1400 m.
- 7: 640a *Cyperus compactus* RETZ.  
Add to literature: K. L. WILSON, Telopea 1 (1980) 462.  
Add to Distr.: Australia: Northern Territory.
- 7: 686a *Oreobolus kükenenthalii* STEEN.  
Add to literature: STEEN. Reinwardtia 10 (1982) 26.
- 7: 687a Add to Distr.: NW. Borneo: Sarawak (4th Div., N. side of Mt Murud), and dot this locality in Fig. 85.  
Add to Ecol.: Forming dense tufts in wet rock holes, 2100 m, BURTT & MARTIN 5482.  
Add Note: Hitherto only known from N. Sumatra and Malaya; Mt Kinabalu is the westernmost locality of another species, *O. ambiguus* KÜK & STEEN.
- 9: 149a *Carex breviscapa* CLARKE.  
Add to Distr.: Central Celebes (Mt Lokilaki: W. MEIJER 9876).  
Add to Ecol.: 1700–2200 m alt.
- 9: 164a *Carex oedorrhampha* NELMES.  
Add to Distr.: Central Celebes (Mt Lokilaki: W. MEIJER 9869).
- Dipterocarpaceae (ASHTON)**
- 9: 239 Line 16 from top: *Cotylelobium* has 5 spp., not 6.
- 9: 242 Paragraph 5: replace 2nd and 3rd sentence by: It is not impossible that they were derived from the Indian subcontinent, as according to geophysical theory this rafted block of land had by the Eocene joined the Asian plate, while, moreover, *Dipterocarpus* could have migrated through S.W. Asia before it became arid in the Miocene.
- 9: 244 Paragraph 2, lines 10–12: *ssp. philippinensis* also in S.E. Borneo; the doubtful sterile specimens belong to *ssp. philippinensis*.
- 9: 246 Line 16 from top: change SASAH into SASAKI.
- 9: 246 Change the last two lines from bottom into: and its intensity would tend to inhibit vector numbers from reaching adequate levels for effective pollination. CHAN (1980) found most species to have high self-incompatibility, but apomictic adventive embryony occurs in several species (see p. 263, 270).
- 9: 257 Line 13 from top: change SASAH into SASAKI.
- 9: 267 Paragraph 'Morphology', line 2, first word: change cylindrical into circular.
- 9: 267 Paragraph 3, line 4, add after 'species level.': *Dipterocarpoideae* differ from other subfamilies in the presence of resin canals and in their multiseriate rays.
- 9: 269 Paragraph 2, last line, add between the brackets: SOMEGO, 1978.
- 9: 272 Line 16 from top: change 'hypochroa' into *hypochra*.  
Line 15 from bottom: change DC. into KURZ).  
Line 4 from bottom: change DYER into KING.
- 9: 273 Line 4 from top: change MIQ. into BL.
- 9: 276 Line 7 from bottom: omit '*Balanocarpus*'.
- 9: 276 Line 5 from bottom: change 'flora' into floral.
- 9: 279 Paragraph 2, lines 8 & 9, change sentence into: The mature fruit of *Pakaraimea* is small, capsular, but the method of germination is unknown.
- 9: 284 Substitute paragraph 5 by: A picture thus emerges of the Asiatic subfamily originating in Central Gondwanaland and migrating eastwards. It appears likely that the family originated in the seasonal tropics; subsequent immigration and rapid diversification in the oceanic climates of S.W. Ceylon, West Malesia and New Guinea being accompanied by a reduction in stamen number and pollen production, and tomentum; and the evolution of a thin-walled and poorly dispersed fruit.
- 9: 290 Line 6 from bottom: change 'sort' into short.
- 9: 293 Line 5 from top: replace '*D. apterus*' by *D. validus*.  
Paragraph 5, line 3: change 'but' into by.
- 9: 304a *Dipterocarpus baudii* KORTH.  
Line 11 from top: change '*D. elongatus* KORTH.' by *D. validus* BL.
- 9: 310a *Dipterocarpus kunstleri* KING.  
Line 16 from top: change '*D. elongatus* KORTH.' by *D. validus* BL.
- 9: 339a In caption Fig. 35 replace 'place' by tree, and add: The collector MUJAH indicates scale.
- 9: 341 *Cotylelobium* PIERRE.  
Paragraph 2, after 'Distr.', change 6 into 5.
- 9: 342b *Cotylelobium melanoxylon* (Hook. f.) PIERRE.  
Delete the Note.
- 9: 344 In caption Fig. 41: *b* belongs to *Vatica umbonata* (Hook. f.) BURCK *ssp. acrocarpa* (SLOOT.) ASHTON, *d–e* to *ssp. umbonata*.
- 9: 355a *Vatica sarawakensis* HEIM.  
Line 11 from top: change '*V. oblongifolia*'

- into *V. sarawakensis*.
- 9: 365a *Vatica mangachapoi* BLCO ssp. *mangachapoi*.  
Under 'Ecol.' line 3: change 'confirmed' into confined.
- 9: 404b *Hopea latifolia* SYM.  
In 'Vern.' change 'jongkang' into *jangkang*.
- 9: 405b *Hopea pierrei* HANCE.  
Add to Distr.: Sumatra (N.W. coast).
- 9: 424a *Hopea plagata* (BLCO) VIDAL.  
Delete the Note.
- 9: 429 In Note under *Subsection Pierrea*, line 1, change 'The New Guinea species' into Some New Guinea species.
- 9: 436b *Hopea siranda* MIQ. under 'Excluded', change '489' into 491.
- 9: 437 *Shorea* ROXB. ex GAERTN. f.  
Under 'Uses', line 4, change 'timber veneer' into veneer timber.
- 9: 448b *Shorea guiso* (BLCO) BL., in synonymy:  
Lines 1 & 2 from top: change '263' into 45.
- 9: 459b *Shorea superba* SYM.  
Under 'Distr.', line 2, read: Sabah, Tidung, Berau; Sampit, sterile coll.).
- 9: 460b *Shorea astylosa* FOXW.  
Delete the third paragraph of the Notes.
- 9: 472 Line 2 from top in text: change 'sepalled' into sepals.
- 9: 483b *Shorea kudatensis* WOOD ex MEIJER.  
In Distr. change 'Kilias' into Kilias.
- 9: 487a *Shorea dealbata* FOXW.  
Under 'Vern.' change 'bunbong' into *bumbong*.
- 9: 491b *Shorea assamica* DYER ssp. *globifera* (RIDL.) SYM.  
Under 'Distr.' delete line 4 and read: Bencoolen.
- 9: 499b *Shorea albida* SYM.  
Under 'Ecol.' line 10: change '6.5' into 65.  
*Ditto* line 21: add after 'community': 3.
- 9: 503 Under *Subsection Smithiana*, line 3, delete 'inflaked'.
- 9: 504b *Shorea smithiana* SYM.  
In 'Vern.' line 3, change 'belong' into *belang*.
- 9: 515b *Shorea platyclados* SLOOT. ex FOXW.  
Delete at the end of the Note: 'not by lateral plagiotropic shoots'.
- 9: 518a In caption Fig. 102, line 2, read: (Sar)awak, Semengoh Arboretum, with collector SALEH standing beside it (Photogr. SMYTHIES).
- 9: 524a *Shorea macrophylla* (DE VRIESE) ASHTON.  
In 'Uses', line 1, read for Illippe: Illipe.
- 9: 529 In Note under *Subsection Auriculatae*, end of line 1, read: three others.
- 9: 541b *Shorea platycarpa* HEIM.  
Note, line 2, read: lowland, dry land forests.
- 9: 542b *Shorea curtisii* DYER ex KING ssp. *curtisii*.  
Note, first sentence, after 'Selangor;', read: subspecies *grandis* may have the same

origin.

- 9: 543b In caption Fig. 113, line 2, add after 'Brunei': The collector is LADI ANAK BIKAS.

- 9: 547a *Shorea parvifolia* DYER ssp. *parvifolia*.  
In 'Vern.' line 2, change 'bung' into *bunga*.

### Droseraceae

- 4: 377, B. J. CONN (Brunonia 3, 1980, 209–216, 2  
5: 557, fig.) gave a review of *Drosera* L. in New  
6: 943 Guinea, where all Malaysian species occur.  
He gave a new key, cited new records, and added a 7th species, which was hitherto only known from lowland savannahs in Northern Australia.

***Drosera banksii* R.Br. ex DC. Prod. 1 (1824) 319; B. J. CONN, Brunonia 3 (1980) 209, f. 2A.**

Similar to *D. peltata* J. E. SMITH, but differing by absence of bracts under the flowers and presence of stipules.

Distr. Northern Australia; in *Malaysia*: Papua New Guinea (W. Div.: near Morehead, JOHNS 2201; Wassi Kussa R., HGF 38747).

Ecol. Under seasonal climatic conditions in open *Banksia dentata* savannahs, with *Melaleuca*, *Acacia*, and *Eucalyptus*, at c. 20 m altitude.

### Ericaceae

- 6: 668 Add the *Rhododendron* species 298–301; see below.

- 6: 483, **298. *Rhododendron capellae* P. KORES,**  
493 *Blumea* 24 (1978) 181, f. 1.

Distr. *Malaysia*: Papua New Guinea, W. Sepik, Mt Capella (Star Mts), 3800 m (LAE 68056).

Note. Keys out to aff. *R. vinkii* SLEUM., but its affinity is obviously with *R. pulleanum* KOORD.

- 6: 490b *Rhododendron scortechinii* K. & G.  
Add to Distr.: Borneo: Sarawak (Mt Mulu, en route from 4th camp to summit, on western ridge), 2000–2400 m (HOTTA 14907).

- 6: 550 **299. *Rhododendron roseiflorum* P. F. STEVENS,**  
*Adansonia* II, 18 (1978) 55, 1 fig.

Distr. *Malaysia*: West New Guinea: Mt Carstensz, near mining on S. slope, 2100–2700 m (RAYNAL 17580, 17672).

Note. Keys out near *R. rutenii* J.J.S.  
6: 580, **300. *Rhododendron burttii* P. J. B.**  
582 *Woods*, Not. R. Bot. Gard. Edinb. 37 (1978) 157, f. 1 a–d.

Distr. *Malaysia*: Borneo: Sarawak (Mt Murud), 1500 m.

Note. Belongs to ser. *Buxifolia*; cultivated at Edinburgh. No affinity given but keys out to *R. frey-wysslingii* J.J.S. from N. Sumatra.

- 6: 568 **301. *Rhododendron rubineiflorum* CRA-**



VEN, Not. R. Bot. Gard. Edinb. 38 (1980) 141, f. 1.

Distr. *Malesia*: Papua New Guinea.

Ecol. Alpine shrubberies, 2650–3400 m.

Note. Closely allied to *R. anagalliflorum* WERNH.

- 6: 646b *Rhododendron nervulosum* SLEUM. var. *exuberans* SLEUM.

Add to literature: P. J. B. WOODS, Not. R. Bot. Gard. Edinb. 37 (1978) 159, f. 1 e–i.

Note. Additional remarks; attention is drawn towards similarity with *R. stenophyllum* Hook. f.

- 6: 657a Correction as follows:

277. *Rhododendron irroratum* FRANCH. ssp. *kontumense* (SLEUM.) CHAMBERLAIN, Not. R. Bot. Gard. Edinb. 37 (1978) 117. — *R. atjehense* SLEUM. Fl. Males. 1, 6 (1966) 657, f. 47 & 48.

Note. *R. irroratum* is a Chinese and Indo-Chinese species.

- 6: 878, Add the following species:

- 777 242. *Vaccinium altiterrae* VELDK. Blumea 25 (1979) 479.

Distr. *Malesia*: Papua New Guinea (Western Highlands: Mts Burgers and Kegum).

Ecol. Edges of *Drimys/Rapanea* coppices, 3400–3675 m.

Note. Allied to *V. oranjense* J.J.S.

- 6: 892b, New reduction proposed:

- 895b *Dimorphanthera amblyornidis* (BECC.) F.v.M. var. *steinii* STEVENS, J. Arn. Arb. 58 (1977) 439. — *D. steinii* SLEUM. Fl. Males. 1, 6 (1967) 895.

- 6: 895, Reduction proposed to variety:

- 892b *Dimorphanthera apoana* (MERR.) SCHLTR. var. *mindanaensis* (MERR.) STEVENS, J. Arn. Arb. 58 (1977) 440. — *D. mindanaensis* MERR.; SLEUM. Fl. Males. 1, 6 (1967) 892.

- 6: 914 Add the following three *Dimorphanthera* species:

71. *Dimorphanthera napuensis* P. F. STEVENS, J. Arn. Arb. 58 (1977) 441.

Distr. *Malesia*: West New Guinea (Baliem; Bele R.; Lake Habbema).

Ecol. Sprawling or scandent shrub in valley forest, 2000–2350 m.

Note. Specimens were confused with *D. wrightiana* (KOORD.) J.J.S. Not assigned to a section.

72. *Dimorphanthera wisselensis* P. F. STEVENS, J. Arn. Arb. 58 (1977) 442.

Distr. *Malesia*: West New Guinea (Wissel Lakes); one collection, formerly confused with *D. wrightiana* (KOORD.) J.J.S.

73. *Dimorphanthera albida* P. F. STEVENS, J. Arn. Arb. 58 (1977) 437.

Distr. *Malesia*: Papua New Guinea, Morobe Distr., Edie Creek, 2700 m, VAN DER KLOET 35875, in fern heath; fl. Aug.

Note. Belongs to sect. *Pachyanthae*,

probably closest to *D. ingens* (SLEUM.) STEVENS.

## Fagaceae

- 7: 277 *Nothofagus* BL.

Unfortunately the typification of the genus *Nothofagus* by *N. betuloides* (MIRB.) OERST. (Taxon 7, 1958, 145) has been overlooked, and consequently some names of infrageneric taxa need correction.

- 7: 278 Changes in the key at the bottom of the page:

Line 1, replace '1. Sect. *Nothofagus*' by: 1. Sect. *Calucechinus* (HOMBR. & JACQ.) KRASSER, and omit this name from line 2. Line 6, replace '1a. Subsect. *Antarcticae* STEEN.' by: 1a. Subsect. *Calucechinus*, and add the former name to its synonymy.

Line 9, replace '2. Sect. *Calusparassus* (HOMBR. & JACQ.) KRASSER' by: 2. Sect. *Nothofagus*, and add the former name to its synonymy.

Line 13, replace '2a. Subsect. *Quadripartitae* STEEN.' by: 2a. Subsect. *Nothofagus*, and add the former name to its synonymy.

- 7: 280 Replace '1. Section *Calusparassus* (HOMBR. & JACQ.) KRASSER' by: 1. Section *Nothofagus*, and add the former name to its synonymy.

- 7: 398 *Trigonobalanus* FORMAN.

Through the paper by D. H. MAI on the Tertiary fossils of the genus in the Eocene in Europe (Jahrb. Geol. 3, 1970, 381–409) it has become clear that the two living species of the genus in West Malesia and Thailand are relicts of a former much larger range. *T. doichangensis*, hitherto only known from Thailand, has now also been recorded from Yunnan (HSU, WANG, WU & LI, Acta Bot. Yunnan. 3, 1981, 213).

This conclusion is now unexpectedly confirmed by the find of a third living species in the mountains of the National Park of Colombia (NW. South America). G. LOZANO-C, J. I. HERNANDES-C & J. E. HENAO-S published this as *T. excelsa* nov. sp. (Caldesia 12 (n. 60), 1979, recvd June 1980, 517–537, 3 pl.). It grows in mountain forest at 1550–1800 m, as a large tree, 20–40 m high. Its leaves are scattered, as in the Thailand-Yunnan species. It is clear that the genus once had an ancient, large Eurasian range. It should also occur in the fossil state in the southern U.S.A.

## Flacourtiaceae

- 5: 46b *Ryparosa javanica* (BL.) KURZ.

Add to Distr.: Lesser Sunda Is. (Flores: Paku, 500 m, SCHMUTZ 4818).

- 5: 51 *Homalium* JACQ.

Craven (Brunonia 2, 1979, 107–124, 9 fig.) has given a new treatment of the Papuan species by proposing 8 new species, by which the number of 2 distinguished by SLEUMER (Fl. Males. I, 5, 1954, 51) has increased to 10, apart from the 11th, *H. tatambense* SLEUM. from the Solomons which is included here. This is surprising to me, the more so as 7 of them are based on a

single specimen. From the key given it appears that single vegetative differences are frequently used for their delimitation and almost all are compared with the widely distributed, very variable *H. foetidum*. Future collections will show whether they will stand the test of time. Craven's key and diagnoses are extracted here:

#### KEY TO THE PAPUASIAN SPECIES

1. Stamens always solitary before each petal.
2. Flowers sessile or subsessile, in simple spikes or racemes.
  3. Leaf-apex long-attenuate, acute; leaf margin entire or obscurely distantly crenate. Papua New Guinea (Morobe Distr.; 1 old coll., not seen) ..... **1. *H. acutissimum* Gilg**
  3. Leaf-apex shortly acuminate, obtuse; leaf margin distinctly crenate. — Differs from *H. foetidum* by sessile flowers and solitary stamens. Papua New Guinea (Western Distr.; 1 coll.) ..... **7. *H. reductum* Craven**
2. Flowers distinctly pedicellate, in racemes or panicles.
  4. Petiole c. 10 mm long. Leaf margin strongly crenate. — Differs from *H. acutissimum* by distinctly crenate leaves and pedicelled flowers in panicles. Papua New Guinea (Madang Distr. and Bagabag I.; 2 coll.); New Ireland (1 coll.) ..... **2. *H. bismarckense* Craven**
  4. Petiole c. 5–6 mm long. Leaf margin weakly crenate. — Differs from *H. acutissimum* by elliptic acuminate leaves and distinctly pedicelled flowers. West New Guinea (Vogelkop; 1 coll.) ..... **3. *H. caput-avis* Craven**
1. Stamens in fascicles of (1) 2 or more before each petal.
  5. Stamens constantly in pairs, one behind the other. Papua New Guinea and Bismarcks, many collections ..... **5. *H. foetidum* (Roxb.) Bth.**
  5. Stamens generally in fascicles of 3 or more.
    6. Leaves broadly ovate to subcordate. Stamens in fascicles of 5–8. — Differs from *H. foetidum* by broad subcordate leaves and stamens in fascicles of 5 or more flowers. Solomons (Guadalcanal; 1 coll.) ..... **9. *H. subcordatum* Craven**
    6. Leaves elliptic to lanceolate. Stamens in fascicles of not more than 5.
      7. Perianth segments sparsely hairy, at least the sepals glandular on the margins. — Differs from *H. foetidum* by glandular perianth. Papua New Guinea (Milne Bay Distr.; 1 coll.) ... **8. *H. streimannii* Craven**
      7. Perianth segments densely hairy and non-glandular.
        8. Leaf margin weakly crenate to entire. — Possibly allied to *H. subcordatum* but different in elliptic narrower leaves and stamens usually in fascicles of 3–4. Solomons (Santa Isabel I.; 1 coll.) ..... **10. *H. tatambense* Sleum.**
        8. Leaf margin distinctly crenate.
          9. Leaves velutinous. — Differs from *H. foetidum* by the velutinous leaves and stamens mostly in fascicles of 3–4. Papua New Guinea (Central Distr.; 1 coll.) ..... **11. *H. velutinum* Craven**
          9. Leaves glabrous.
            10. Leaf margin entire in the basal 1/3–1/2. Branchlets glabrescent. — Differs from *H. foetidum* by: petals and sepals similar, stamens mostly in fascicles of 3. Normanby I. (1 coll.) ..... **4. *H. dentrecasteauxense* Craven**
            10. Leaf margin wholly crenate. Branchlets glabrous. — Differs from *H. foetidum* by larger flowers and stamens in fascicles of 3–5. Papua New Guinea (Milne Bay Distr.; 1 coll.) ..... **6. *H. maneauense* Craven**

#### Flagellariaceae

- 4: 249b *Hanguana malayana* (Jack) Merr.  
Add to Distr.: N. Australia: Northern Territory, cf. Airy Shaw, Kew Bull. 33 (1978) 4.  
Note. The specimens belong to var. *anthelminthica* (Bl.) Bakh. f.
- 4: 249 *Hanguana major* Shaw, Kew Bull. 35 (1981) 819, 1 fig.

This proposed new species, confined to the Kinabalu area, differs from the com-

moner form with small, globular fruits closer set, by spaced, larger, ovate-acute fruit up to 1.5–2 by 1.25 cm. Shaw added that the small-fruited form does not occur in this area.

The species *H. malayana*, as conceived by Backer (Fl. Males. I, 4, 1951, 249) is admittedly variable, Backer mentioning the fruit also to attain 2 cm. Extensive field observation would be needed to check the racial and population variability in detail over the entire range.



## Geraniaceae

4: 445 *Geranium* LINNÉ.

The number of Malasian species, according to CAROLIN (Fl. Males. I, 6, 1964, 445) 3 and one variety, has unexpectedly been increased by VELDKAMP & MOERMAN (Blumea 24, 1978, 463–477) to 15, including 9 new species from New Guinea and 1 from SW. Celebes. In their introduction the authors state that the evaluation of taxonomic status of these taxa has posed a bit of a problem, which they have not been able to solve

to their satisfaction, but further consideration has induced them 'to regard the taxa as species'. These considerations are, amongst others, that there may be chromosome taxa, that most taxa are represented by more than one collection, and that they appear to be homogeneous, although in several cases occurring on more than one mountain. In the key the exact description of the leaves plays an important role. Future research, especially karyologic, must show whether the specific status of the new species can be maintained.

## KEY TO THE SPECIES

1. Leaves (sub)compound, middle 'leaflet' free for at least 0.9th of its length.
  2. 'Leaflets' repeatedly 2–3-partite with  $\pm$  linear-lanceolate, overlapping segments; the middle 0.2–0.3 mm wide at base. Papua New Guinea (Mt Suckling; 4 coll.) ..... **9. *G. leptodactylon*** VELDK.
  2. 'Leaflets' 3-lobed to -fid, segments broader, not overlapping, the middle 0.3–1 mm wide at base. Papua New Guinea (Star, Saruwaket, Owen Stanley Mts; 12 coll.) ..... **13. *G. subcompositum*** VELDK.
1. Leaves palmatifid to -partite, middle segment free for at most 0.9th of its length, usually much less.
  3. Lower leaf surface very densely grey to silvery hairy, sometimes brown when dried, the indument obscuring the venation. West New Guinea (Carstensz to Star Mts; 15 coll.) ..... **10. *G. monticola*** RIDL.
  3. Lower leaf surface variously strigose, the indument not obscuring the venation, often making it more prominent, instead.
    4. Middle leaf segment entire, the laterals sometimes with a lobe, rarely the middle segments of some leaves 2- or 3-lobed, leaves then glabrous on the upper surface, 5-partite, and petals pink.
      5. Upper surface of the leaves strigose-setose. Peduncle at anthesis already 18–23 mm long. Papua New Guinea (Mt Saruwaket; 1 coll.) ..... **6. *G. editum*** VELDK.
      5. Upper surface of the leaves glabrous. Peduncle in fruit 0–11 mm.
        6. Leaves 7-fid, middle segment free for 0.5–0.6th of its length, 0.8–2 mm wide at the base of its free part. Papua New Guinea (Mts Giluwe, Wilhelm, Bangeta; 10 coll.) ..... **7. *G. hyperacrium*** VELDK.
        6. Leaves 5-partite, middle segment free for 0.8–0.9th of its length, 0.5–0.7 mm wide at the base of its free part. West New Guinea (Mt Wilhelmina; 3 coll.) ..... **15. *G. wilhelminae*** VELDK.
    4. Middle leaf segment lobed, in some upper or reduced leaves occasionally entire and rarely also glabrous on the upper surface, then 5–7-fid or petals purple.
      7. Upper leaf surface glabrous or sparsely and patchily long-strigose.
        8. Petals 9–16 mm long, purple (? always), 1.7–2.1 times as long as the 5.5–7.6 mm long sepals. West New Guinea (Carstensz, Star, Piora Mts; 9 coll.) ..... **12. *G. papuanum*** RIDL.
        8. Petals 4.5–6 mm long, white to pink, 1.2–1.4 times as long as the 3.5–4.8 mm long sepals.
          9. Upper leaf surface patchily long-strigose. West New Guinea (Mt Wilhelmina; 1 coll.) ..... **8. *G. lacustre*** VELDK.
          9. Upper leaf surface glabrous or with some long hairs near the margin. Papua New Guinea (Wharton Ra.; 6 coll.) ..... **14. *G. whartonianum*** VELDK.
  7. Upper leaf surface evenly strigulose to strigose.
    10. Leaf blade fairly large, usually over 15 by 25 mm.
      11. Inflorescences strictly 1-flowered. Peduncle 25–41 mm. Sepals 5–6 mm long, in fruit 7.5–9 mm. Petals 5.5–7.5 mm long. Java (Mt Merbabu eastward to Mt Tengger; 13 coll.) ..... **2. *G. ardjunense*** Z. & M.
      11. Inflorescences usually 2-flowered. Pedicels 9–16 mm. Sepals 3.5–5 mm long, in fruit 3.8–7.5 mm. Petals 3.5–6 mm long. New Zealand, Tasmania, East Australia, Timor, East Java (Mt Tengger); 12 coll. .... **3. *G. homeanum*** TURCZ.
    10. Leaf blade fairly small, usually less than 15 by 25 mm.
      12. Middle leaf segment pinnately lobed. Peduncle in fruit 55–150 mm. Ceylon, Nilghiris, Himalayas (Afghanistan to W. China), N. Sumatra (one coll.) ..... **1. *G. nepalense*** SWEET
      12. Middle leaf segment 3-lobed, its outer lobes rarely with a lateral tooth. Peduncle in fruit 0–45 mm.
        13. Leaf blades 7-fid to -partite. Peduncle in fruit 0–3 mm long. Papua New Guinea (Star, Kinkain, Wilhelm and Saruwaket Mts; 11 coll.) ..... **5. *G. balgooyi*** VELDK.
        13. Leaf blades 5-partite. Peduncle in fruit 6–45 mm.
          14. Inflorescences 1- or 2-flowered. Peduncle in fruit 6–20 mm, pedicel then 4–15 mm. Petals red-purple. SW. Celebes (Mt Bonthain; 2 coll.) ..... **4. *G. frigidurbis*** MOERMAN

14. Inflorescences strictly 1-flowered. Peduncle in fruit 19–45 mm, pedicel then 16–31 mm. Petals white to pinkish. Papua New Guinea (Sugarloaf, Giluwe, Saruwaket to Dayman Mts; 24 coll.)

**11. *G. niuginiense* VELDK.**

**Goodeniaceae**

- 5: 339a, **1. *Scaevola sericea* VAHL**, Symb. Bot. 2  
6: 951a (1791) 37. — *S. taccada* (GAERTN.) ROXB.  
Hort. Beng. (1814) 15. JEFFREY, Kew Bull.  
34 (1980) 543.

For extremely formal meticulous-nomenclatural reasons JEFFREY has advanced that *S. sericea* should be the proper combination.

**Hydrocharitaceae**

- 5: 396a, Change 1. *Limnobia stoloniferum* (laevigata) into:

**1. *Hydromystria laevigata* (H. & B. ex WILLD.) DIAZ-MIRANDA & PHILCOX**, Bot. J. Linn. Soc. 83 (1981) 321, 6 fig.

The generic name *Hydromystria* G. MEYER, Prim. Fl. Esseq. (1818) 152 antedates the synonym *Limnobia* RICH. ex STEUD. (1841).

**Icacinaceae**

- 7: 15 *Gonocaryum* MIQ.  
Add to Distr.: Lesser Sunda Is. (West Flores), probably *G. macrophyllum* (BL.) SLEUM.

- 7: 55 Replace the name *Nothapodytes foetida* by:  
**1. *Nothapodytes nimmoniana* (J. GRAH.) MABBERLEY** in K.S. Manilal (ed.), Bot. Hist. Hort. Mal. (1980) 88; Taxon 29 (1980) 606. — *N. foetida* (WIGHT) SLEUM.; Fl. Males. I, 7 (1971) 55. — *Premna nimmoniana* J. GRAH. Cat. Pl. Bombay (1839) 155.

The basionym antedates that of *Stemonurus foetidus* WIGHT by six years.

- 7: 56 *Stemonurus* BL.  
Add to Distr.: Lesser Sunda Is. (Flores; near Paku, 900 m, SCHMUTZ 3371, specimen in fr.; identified by SLEUMER).

This collection nicely fills a gap in the generic range and shows again that the Lesser Sunda Islands flora fits in with the rest of Malesia.

- 7: 73 *Sarcostigma* W. & A.  
Add to Distr.: Lesser Sunda Islands (Flores).  
7: 75b *Sarcostigma paniculata* PIERRE.  
Add to Distr.: Lesser Sunda Is. (Flores; Paku, 500 m, SCHMUTZ 4818a).

**Juncaceae**

- 4: 213b *Juncus bufonius* L.  
Add to Distr.: Borneo (Sabah: Mt Kinaba-

lu), 3300–3760 m alt.

VELDKAMP (Reinwardtia 10, 1982, 25) noted that the specimens differ in many details from the common form. I still consider it an alien brought by tourists.

4: 214

Add the following species:

**5. *Juncus nupela* VELDK.** Blumea 24 (1977) 415.

Distr. *Malesia*: Central New Guinea (Star Mts, Tel Basin, 3000 m, VELDKAMP 6369).

Note. The author finds this to be allied to the northern hemisphere *J. balticus* WILLD. and tabulated differences with three other species, including *J. inflexus* L. No developed ovules could be found.

4: 214

*Luzula* DC.

R. BROWN and BENTHAM assumed the Australasian specimens of *Luzula* to belong to a broad concept of *L. campestris*. In this they were followed by BUCHENAU in his monograph, except that the latter distinguished them to represent an outlying variety, *var. australasica*. MERRILL (1922) accommodated the Philippine specimens also in *L. campestris sensu lato*. BACKER (Fl. Males. I, 4, 1951, 215) identified the Philippine and Papuan specimens as belonging to the variety.

The precise naming of the Australasian specimens of this affinity complex from Australia, Tasmania and New Zealand has given rise to a confused nomenclature and species distinction which M. E. JANSEN has tried to solve (Blumea 24, 1978, 527–532, 1 fig.). For Malesia he distinguished two new endemic species, *L. philippinensis* M. E. JANSEN and *L. papuana* M. E. JANSEN. In the key he did not include how they are distinguished from *L. campestris* (L.) DC. It must be left to a future monographic study of the genus to see whether these two taxa can be upheld at specific rank.

**Labiateae**

- 8: 338b *Leucas lavandulifolia* J. E. SM. Change into:

**3. *Leucas linifolia* (ROTH) SPRENG.** Syst. Veg. ed. 15, 2 (1825) 743; BTH. Lab. Gen. Sp. (1834) 617, (1835) 744; FOSBERG & SACHET, Smithsonian. Contr. Bot. 47 (1981) 25. — *Phlomis linifolia* ROTH, Nov. Pl. Sp. Ind. Or. (1821) 260. — *L. lavandulaefolia* J. SM. in Rees, Cycl. (1812) LEU 20, *nom. illeg.* (superfl.); KENG, Fl. Males. I, 8 (1978) 338.

Note. SMITH's name is illegitimate as a



superfluous name since he cited *Leonurus indicus* L. as a synonym. *Leonurus indicus* can no longer be transferred to *Leucas*, because of *L. indica* R.BR. ex SPRENG., based on *Phlomis indicus* L.

- 8: 340b *Leucas flaccida* R.BR. Change into:  
**6. *Leucas decemdentata*** (WILLD.) J.SM. in Rees, Cycl. (1812) LEU 20; DRAKE, Ill. Fl. Ind. Mar. Pac. (1890) 263; FOSBERG & SACHET, Smithsonian. Contr. Bot. 47 (1981) 25. — *Stachys decemdentata* SOL. ex FORST. f. Prod. (1768) 91, nomen. — *Phlomis decemdentata* WILLD. Sp. Pl. 3 (1800) 124. — *L. flaccida* R.BR. Prod. (1819) 505; KENG, Fl. Males. I, 8 (1978) 340. — *L. stachyoides* SPRENG. Syst. Veg. ed. 15, 2 (1825) 743.
- 8: 361 *Satureia gracilis* (BTH.) LOES.  
 Add to Distr.: Borneo: Sabah (Headquarters Taman Negara Sabah, c. 1560 m alt., R. H. WILLEMSE 605, in disturbed places).

### Liliaceae

- 9: 213 *Thysanotus tuberosus* R.BR.  
 In a recent revision of the genus *Thysanotus* N. H. BRITTAN (Brunonia 4, 1981, 67–181) assigned the Papuan specimens to *T. banksii* R.BR., a name which since BENTHAM's Flora was considered a synonym. In the key it appears that the minute differential characters either do not hold or are inconsistent with the descriptions. I cannot accept *T. banksii* as a distinct species.
- 9: 234a *Astelia alpina* R.BR.  
 Add to Distr.: West Central Celebes (Latimodjong Range; Mt Rante Mario, summit zone, very local).  
 Note. The collection was made by Dr. J. M. B. SMITH in February 1981 and is a remarkable addition.

### Loganiaceae (LEENHOUTS)

- 6: 293 Wood anatomy. See A. M. W. MENNENGA in E. & P. Nat. Pfl. Fam. ed. 2, 28b I (1980) 112–161.  
 Palynology. See W. PUNT in E. & P. Nat. Pfl. Fam. ed. 2, 28b I (1980) 162–191.
- 6: 294 Phytochemistry. See N. G. BISSET in E. & P. Nat. Pfl. Fam. ed. 2, 28b I (1980) 211–237.
- 6: 295 Delimitation and subdivision. See A. J. M. LEEUWENBERG *et al.* in E. & P. Nat. Pfl. Fam. ed. 2, 28b I (1980) 1–255.  
 FOSBERG & SACHET (Smithson. Contr. Bot. 45, 1980, 18–19) suggest the combination of *Loganiaceae-Potalieae* with *Gentianeaceae-Tachiineae*, preferably as part of the *Gentianeaceae*, but on rather vague and superficial arguments. This seems at least contrary to wood anatomical data (MENNENGA, l.c. 158) and to palynology (PUNT, pers.

comm., 1980).

- 6: 308a *Fagraea fragrans* ROXB.  
 Add to Distr.: Ceylon, the whole of Indo-China, SW. New Guinea.
- 6: 320a Insert the following species:  
**8a. *Fagraea graciliflora*** LEENH. Blumea 27 (1981) 209.

Distr. *Malesia*: Central Celebes (Mt Roroka Timbu; VAN BALGOOY 3247, DE VOGEL 5390).

Ecol. Montane ridge forest dominated by conifers and *Fagaceae*, at c. 2100 m. Fl. May.

Note. Though the texture of the flowers and the distinctly exerted stamens and style remind of the situation in *sect. Cyrtophyllum*, the new species will have to be included in *sect. Fagraea* which is the most primitive in the genus (cf. PUNT & LEENHOUTS, Grana Palynol. 7, 1967, 510–515). It is closest allied to *F. tubulosa* BL. which is found in Sumatra and Malaya.

In the key given in Fl. Males. I, 6 (1962) 302, the new species keys out under the first lead of couplet 19 as *F. tubulosa* BL. from which it can be distinguished as follows:

- 19a. Leaves about 2 times as long as wide. Inflorescences glomerulous, with bracteoles . . . . . **8. *F. tubulosa***
- 19a. Leaves 13.5–22 by 4–6.5 cm, 2.5–4 times as long as wide. Inflorescence a terminal 3-flowered cyme and in the axil of the upper leaf-pair either a cyme or a solitary flower. Bracteoles absent . . . . . **8a. *F. graciliflora***

- 6: 320b *Fagraea ridleyi* K. & G.  
 Add to Notes: Though typical specimens of *F. blumei* and *F. ridleyi* are clearly distinct, fruiting material is not always easy to name, especially in Borneo. As a whole the number of flowers and fruits is smaller in the present species, the pedicel and calyx in fruit are less densely warty, the calyx is larger, the nerves are fewer in number and more prominent beneath, the axillary scales are less conspicuous, and the dried leaves are more olive yellow, in contrast to the usually dark reddish brown ones of *F. blumei*.
- 6: 328a *Fagraea auriculata* JACK.  
 Add to Distr.: Great Nicobar (cf. Fl. Males. Bull. no 29, 1976, 2547) and Celebes.
- 6: 328b Add to Notes: VAN BALGOOY 3492 from Central Celebes combines the long-petioled leaves with small auricles of *ssp. parviflora* with the large flowers of *ssp. auriculata*. The collection VAN BALGOOY 3678, also from Central Celebes, represents *ssp. borneensis*.
- 6: 331a *Fagraea resinosa* LEENH.  
 Add to description: Tree, 7.5–9 m by 2–20 cm, or climber. Leaves 8–16 cm long, width from 3.5 cm onwards. Bracteoles 2

and 3 cm resp. Calyx 3–3.5 cm high, in fruit up to 4 cm.

Add to Distr.: Sarawak (4th Div.), N. Borneo (Mt Kinabalu; Sandakan Distr., Telupid).

Add to Ecol.: Altitude up to 1550 m.

- 6: 336 *Buddleja* HOUST. ex LINNÉ.

Add to literature: LEEUWENB. Meded. Landbouwhogeschool 79-6 (1979) 1–163.

- 6: 359a *Strychnos axillaris* COLEBR.

Add to Distr.: Ceylon.

- 6: 365, 959 *Neuburgia corynocarpa* (A. GRAY) LEENH.

In a detailed study of the specimens of *N. corynocarpa* in Papua B. J. CONN (Brunonia 2, 1979, 99–105, 4 fig.) has come to the conclusion that *N. sarcantha* (GILG & BENED.) LEENH. Fl. Males. I, 6 (1962) 366 cannot well be distinguished at specific level. Accordingly he reduced this to a variety of the former, *var. sarcantha* (GILG & BENED.) B. J. CONN, which he keyed out (l.c. 104). He also described the structure of seedlings.

Distr. Add: Moluccas (Obi) and New Ireland.

Note. An isotype of *N. sarcantha* is found in B (LEDERMANN 13005) and replaces the neotype with which it completely agrees.

- 6: 371 *Geniostoma* FORST.

Recently B. J. CONN (Blumea 26, 1980, 245–364, 29 fig.) made a world revision of the genus resulting in the name change of one and the creation of a new species. He also gave a new key to the species of Papua (incl. Solomons). In using my key (Fl. Males. I, 6, 1962, 371) the two can be accommodated in couplet 3, second lead, after:

3. Corolla 2–4 mm long.

4. Pistil hairy . . . . . 4. *G. antherotrichum*

4. Pistil glabrous . . . . . 5. *G. leenhoutsii*

4. *Geniostoma antherotrichum* GILG & BENED. Bot. Jahrb. 54 (1916) 158, f. 2; LEENH. Fl. Males. I, 6 (1962) 371, as syn. under *G. rupestre*; B. J. CONN, Blumea 26 (1980) 317, f. 15. — *G. arfakense* KAN. & HAT. Bot. Mag. Tokyo 56 (1942) 163, f. 7; LEENH. Fl. Males. I, 6 (1962) 373.

Note. This species has a variety: *var. archboldianum* (MERR. & PERRY) B. J. CONN, Blumea 26 (1980) 320, f. 15G. — *G. archboldianum* MERR. & PERRY, J. Arn. Arb. 23 (1942) 408.

Distinct by smaller leaves (2–6 by 1–2 cm) and flowers solitary or in triads. A few collections intermediate with the type variety.

5. *Geniostoma leenhoutsii* B. J. CONN, Blumea 26 (1980) 323, f. 17.

Distr. Solomons (type), in *Malesia*: Papua New Guinea (Central Distr.: Woitape); in all 2 specimens known.

Note. I doubt whether this new species will be tenable. — Edit.

### Myoporaceae

- 4: 265a *Myoporum papuanum* KRAENZL.

Add to Distr.: Lesser Sunda Is.: W. Timor (Kie, near Amanubar, C. W. Koox 1271, dated 7-2-1981).

### Pittosporaceae

- 6: 962b *Pittosporum pumilum* SCHODDE.

Add to literature: STEEN. Blumea 24 (1978) 482.

Add to description: Pedicels 6 mm. Flowers functionally female, deep purple. Sepals 5, free, ovate-oblong, blunt, long-hairy, 5 by 2.5 mm. Petals 5(–6), cohering at base, ligulate, glabrous, bent outwards, apex rounded, c. 12 by 2.5 mm. Stamens reduced, c. 3 mm. Ovary densely brown-hairy, ellipsoid, 4 by 2 mm; style glabrous 1 mm. Fruit red to deep-brown.

Add to Distr.: Papua New Guinea, Mt Kenive (Nisbet), 2500 m, LAE 65011; fl. July.

### Proteaceae

- 5: 195b *Macadamia hildebrandii* STEEN. Add:

Uses. This endemic tree of Celebes has been successfully planted as a fire-lane tree in the very large plantations of *Pinus merkusii* in the Aek na Uli area, on the north flank of Toba Lake (N. Sumatra). Thirty years old trees have the virtue of keeping dense foliage and branching from the base upwards.

### Rhizophoraceae

- 5: 429 The distinction of sterile material of *Rhizophora* and *Bruguiera* may give difficulty. Dr. DING HOU found an easy way for identification (Blumea 10, 1960, 628) by means of a hand-lens. In *Bruguiera* the leaf-scars show 3 distinct, usually horseshoe-shaped bundles of leaf traces. In *Rhizophora* there are several vascular bundles in two rows or a crescentic pattern. This was recently also advanced by KENNEALLY c.s. in their work on Australian mangroves (Nuytsia 2, 1978, 178–180, 1 fig.).

### Styracaceae

- 4: 53a *Styrax crotonoides* CLARKE ssp. *fraserensis* (PUTZ & NG) STEEN., *comb. nov.* — *S. fraserensis* PUTZ & NG, Mal. For. 40 (1977) 249, f. 1; Tree Fl. Malaya 3 (1978) 263.

A small tree. Average mature leaves 6–10.5 by 2.5–5 cm; nerves 4–6 pairs.



Fruits roundish, c. 2 cm diam.

Distr. *Malesia*: Malaya: Fraser's Hill, at c. 1300 m.

Notes. I have carefully compared the descriptive data with those of *S. crotonoides*, but find no essential differences, and also that the ones mentioned are slightly overlapping. In the species the mature leaves average 8.5–20 by 4–10 cm, nerves 5–9 pairs. Fruit round to ovoid, tending to have a smallish or indistinct tip at apex, 1.7–3 cm diam. Lowland, 90–300 m.

Obviously a hill race, with smaller leaves. The shape of the fruit induced me to maintain it as a taxon.

4: 54b *Styrax ridleyanum* PERK.

PUTZ & NG (Tree Fl. Malaya 3, 1978, 264) have discarded this from Malaya and find the specimen YEOP KEP 3639 best to place under the allied *S. benzoin* DRYAND. because of the short inflorescence. I must admit that this is indeed no differentiating character. I had no opportunity to re-study this specimen.

However, another one, also with short inflorescence, exactly tallies with the differences with *S. benzoin* as given in the key of my elaborate treatment (Bull. Jard. Bot. Btzig. III, 12, 1932, 223): twigs dark brownish; leaves with smaller stellate scales than in *S. benzoin*; buds rather broad; petals inside appressed-pubescent all over; connective *ditto*; stigma 3-lobed, much wider than the style.

Distr. *Malesia*: Malaya: K. Trengganu, Bt Lah, off Sg. Nerus, near Kp. Merjor, SINCLAIR & KIAH SF 40896 (dupl. in L).

Note. I expect that KEP 3639 from Kuantan will turn out to belong to *S. ridleyanum*, as I studied this in 1932.

### Symplocaceae

8. 239b Insert the following species:

**5a. *Symplocos columbuli*** NOOT. Blumea 26 (1980) 417, fig.

Distr. *Malesia*: N. Sumatra, Leuser Reserve, in montane moss forest, 2100–2500 m.

Note. In NOOTEBOOM's key to fruiting material (Fl. Males. I, 8, 1977, 231) it comes out in two places because the leaves are hairy underneath but finally glabrous, viz. via lead 3a to couplet 8, from the two species of which it is distinguished by: fruits narrow-ellipsoid, c. 15 mm long, with c. 10 conspicuous lengthwise ribs. Via lead 3b one arrives at couplet 25, where the same characters single it out.

Sofar only known in the fruiting state; affinity probably with *S. atjehensis* NOOT. from the same area.

8: 267

***Symplocos ophirensis*** CLARKE var. *kaliensis* STONE, Mal. For. 43 (1980) 260, f. 6.

Distr. *Malesia*: Malaya: Pahang, G. Ulu Kali, STONE 13965.

Note. According to STONE closest to var. *densereticulata* NOOT., differing in a glabrous disk, branches, and fruit, style 5 mm. From all other varieties different by a rounded leaf base and a convex petiole.

### Ulmaceae

8: 61b

*Celtis paniculata* (ENDL.) PLANCH.

Add to synonymy: *Strombosia philippinensis sensu* LAM & HOLTH. Blumea 5 (1942) 178.

Add to Distr.: Moluccas (Talaud Is.: LAM 3175).

### Umbelliferae

4: 131

Add the following species:

**5. *Oreomyrrhis plicata*** MATHIAS & CONSTANCE, J. Arn. Arb. 58 (1977) 190, f. 1–6. — Fig. 3.

Leaves tufted at apex of a thick, hardly branched ligneous stem 5–15 cm long, erect, linear to lanceolate, 1-pinnate, the sheathing petiole about as long as the blade; blade 1–4 cm by 1–3 mm, plicate, segments 5–11, linear, 2–5 mm long, erect, entire. Peduncles erect, solitary, exceeding the leaves, 2.5–12 cm long. Flowers pedicelled, in a head.

Distr. *Malesia*: Papua New Guinea (Mt Suckling, summit of Goë Dendeniwa: VELDKAMP & STEVENS 5748), 3325–3625 m, rocky ridges.

Note. Distinctly different from all other species by the simply pinnate leaves, folded lengthwise, with closely adpressed, linear, entire leaf segments.

4: 131b

Replace 2. *Apium tenuifolium* by:

**2. *Apium leptophyllum*** (PERS.) F.v.M. ex BTH. Fl. Austr. 3 (1866) 372; BACK. & BAKH. f. Fl. Java 2 (1965) 175. — *Cnidium tenuifolium* MOENCH. Meth. (1794) 98, excl. syn. *Pimpinella dioica* L., nom. illeg. — *Pimpinella leptophylla* PERS. Syn. 1 (1805) 324. — *Helosciadium leptophyllum* (PERS.) DC. Mém. Soc. Phys. Genève 4 (1828) 493; Prod. 4 (1830) 105, cum syn. numer. — *Apium tenuifolium* (MOENCH.) THELL. in Hegi, Ill. Fl. Mitteleur. 5, 2 (1926) 1140, nom. illeg.; BUWALDA, Fl. Males. I, 4 (1949) 131.

Distr. Southern hemisphere, introduced in various countries: Europe, India, Taiwan, Pacific Islands (Hawaii: Kauai; Fiji, H. J. LAM 6827); in *Malesia*: Java (W.: Lembang; E.: Pudjong, Trètès, EVERAARTS, in litt.), Philippines (Luzon: Ba-

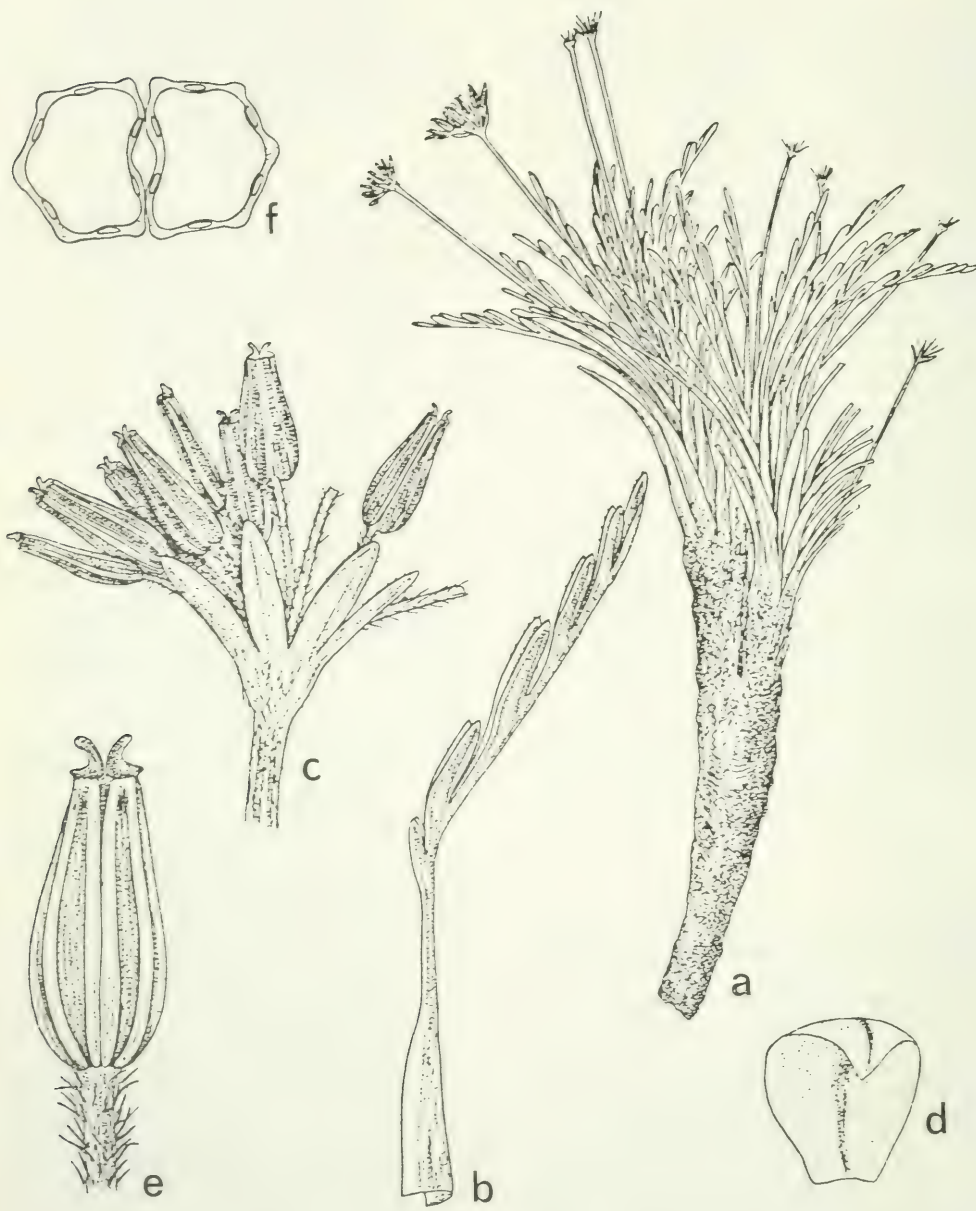


Fig. 3. *Oreomyrrhis plicata* MATHIAS & CONSTANCE. *a.* Habit,  $\times 0.5$ , *b.* foliage leaf, nat. size, *c.* fruiting umbel,  $\times 2.5$ , *d.* petal,  $\times 9$ , *e.* intact mature fruit,  $\times 7$ , *f.* fruit transection,  $\times 10$  (Courtesy Journal Arnold Arboretum).



guio, PNH 35028, 35842), Papua New Guinea (Western Highlands, Minj Distr., NGF 41801; Morobe Distr., Sattelberg, CLEMENS 1720; Wau: NGF 29146; Goroka: McKEE 1160).

Ecol. Fields, wastelands, roadsides, old

walls, 800–1500 m alt.

**Xyridaceae** (B. HANSEN, Copenhagen)

4: 368 Replace the key to the species of *Xyris* L. by the following:

# KEY TO THE SPECIES

1. Median bracts at apex emarginate, margin otherwise entire, grey field 2 by 1.2 mm. Burma, Thailand, Vietnam ..... **X. lobbii** RENDLE
1. Median bracts not emarginate, although sometimes irregularly torn, if emarginate then margins obviously lacerate above.
  2. Median bracts with upper margin lacerate.
    3. Margin of leaves formed by numerous retrorsely pointing, coalescent rows of cells, rough from small tubercles; scape compressed, usually with two strong ridges ..... **1. X. complanata**
    3. Margin of leaves not so; scape terete, with low ridges ..... **2. X. bancana**
  2. Median bracts not lacerate at margin, rarely with a few dents.
    4. Scape terete with 6–15 longitudinal ridges, leaves up to 8 mm wide with short transverse ribs connecting the longitudinal ones ..... **3. X. indica**
    4. Scape terete to compressed, without ridges or with 1–7 ridges, leaves never with transverse ribs.
      5. Leaves 6–20 mm wide, inflorescence depressed hemispherical, wider than long; plant extremely robust ..... **4. X. grandis**
      5. Leaves up to 6, rarely 7.5 mm wide, inflorescence ellipsoid, globular or longer than wide.
        6. Median bracts without a greenish or greyish field below apex, at most with a  $\pm$  conspicuous, narrow ridge ..... **5. X. capensis**
        6. Median bracts with a greyish or greenish field below apex.
          7. Leaf sheath with margin  $\pm$  finely ciliate below, oblong-triangular greyish-brown field below apex of median bracts 3–10 times longer than wide, not protruding upwards ..... **6. X. wallichii**
          7. Leaf sheath not ciliate below, triangular greyish field below apex of median bracts at most 2.5 times longer than wide.
            8. Scape 4-angular with papillate longitudinal ridges; leaves with papillate margins, otherwise smooth ..... **7. X. oligantha**
            8. Scape terete, without ridges.
              9. Lateral sepals with smooth, entire crest.
                10. Plants gracile, leaves at most 3 mm wide, often rough by protruding cell walls (when dry), grey field on median bracts ridge-like protruding towards apex of bract ..... **8. X. pauciflora**
                10. Plants robust, leaves more than 3 mm wide, not rough, grey field on median bracts not protruding towards apex of bract although convex. Burma, Thailand, Laos, Cambodia, Vietnam ..... **X. intersita** MALME
              9. Lateral sepals with crest coarsely serrate, often by 1–3 dents only.
                11. Plants robust, field on median bracts 1.8–2.6 by 1.4–2.6 mm, not protruding; with subglobose underground tubers. Thailand, Laos, Cambodia ..... **X. tuberosa** RIDL.
                11. Plants gracile, grey field on median bracts 1–2.2 by 0.4–1.5 mm, ridge-like protruding towards apex of bract; without tubers ..... **8. X. pauciflora**

4: 369 **1. Xyris complanata** R.BR. Prod. 1 (1810) 256; v. ROYEN, Fl. Males. I, 4 (1953) 369. — *X. indica* auct., non LINNÉ: VAHL, Symb. Bot. 3 (1794) 7, p.p. *quoad spec.* KOENIG. — *X. anceps* auct., non LAMK: VAHL, En. Pl. 2 (1805) 205. — *X. elongata* RUDGE, Trans. Linn. Soc. 10 (1811) 289. — *X. walkeri* KUNTH, En. Pl. 4 (1843) 19. — *X. malaccensis* STEUD. Syn. Pl. Glum. 2 (1855) 287.

Distr. Ceylon, India, China (Hainan), Indochina, Thailand, throughout *Malesia* to Australia.

Ecol. Open, wet places on sandy soil, often among grasses and *Sphagnum*, from sea level to 1600 m.

**2. Xyris bancana** MIQ. Fl. Ind. Bat., Suppl. (1861) 608; v. ROYEN, Fl. Males. I, 4 (1953) 369, incl. var. *lacerata* v. ROYEN, l.c. 370. — *X. ridleyi* RENDLE, J. Bot. 37 (1899) 505; v. ROYEN, Blumea 7 (1953) 309, incl. var. *penicillata* v. ROYEN, Fl. Males. I, 4 (1953) 370, 371. — *X. borneensis* RENDLE, J. Bot. 37 (1899) 506; v. ROYEN, Fl. Males. I, 4 (1953) 370. — *X. chinensis* MALME, Svensk Bot. Tidskr. 21 (1927) 386. — *X. glauccella* MALME, Bull. Jard. Bot. Btzig III, 10 (1929) 388. — *X. subcomplanata* MALME, Bull. Mus. Hist. Nat. Paris II, 2 (1930) 685. — *X. papuana* v. ROYEN, Blumea 7 (1953) 307; Fl. Males. I, 4 (1953) 371.

Distr. Thailand, Cambodia, Vietnam,



Fig. 4. Distribution of *Xyris bancana* Miq. The dots provided with an oblique line represent localities above 1000 m altitude.

Hong Kong; in *Malesia*: Sumatra (Banka), Malaya (Kedah Peak), Borneo, New Guinea (Misool I.; Aru Is.: Trangan) as far east as Sepik. Fig. 4.

Ecol. On (temporarily) boggy or wet, invariably acid, sandy soils (kerangas, sandstone, heath woodland), largely confined to low altitudes below 100 m, but in Indochina and Malaya at 1100–1300 m and in West New Guinea on the Star Mts at 1200–1300 m and on white sands in the Baliem Valley at 2000 m, nowhere at altitudes between. Fig. 4.

3. *Xyris indica* LINNÉ, Sp. Pl. 1 (1753) 42;

v. ROYEN, Fl. Males. I, 4 (1953) 373. — *X. robusta* MART. in Wall. Pl. As. Rar. 3 (1832) 30. — *X. calocephala* MIQ. Fl. Ind. Bat. 3 (1857) 527. — *X. capito* HANCE, J. Bot. 14 (1876) 262.

Distr. Ceylon, India, Burma, China (Hainan), Thailand, throughout *Malesia* to Australia.

Ecol. On open, swampy places and along or in ricefields in the lowland, rarely up to 900 m.

4. *Xyris grandis* RIDLEY, J. Linn. Soc. Bot. 38 (1908) 332; v. ROYEN, Fl. Males. I, 4 (1953) 372. — *X. chlorocephala* v. ROYEN,



Blumea 7 (1953) 308; Fl. Males. I, 4 (1953) 372.

Distr. Indochina, Thailand, in *Malesia*: Malay Peninsula, Sumatra.

Ecol. In wet places, among mosses over rocks, 500–2200 m.

5. *Xyris capensis* THUNB. Prod. Fl. Cap. (1794) 12; NILSSON, Öfvers. Förh. Kongl. Svenska Vet.-Akad. 48 (1891) 155, *incl. var. nilagirensis* (STEUD.) NILSSON *et var. schoenoides* (MART.) NILSSON; v. ROYEN, Fl. Males. I, 4 (1953) 374, *incl. var.* — *X. schoenoides* MART. in Wall. Pl. As. Rar. 3 (1832) 30. — *X. nilagirensis* STEUD. Syn. Pl. Glum. 2 (1855) 288. — *X. melanocephala* MIQ. Fl. Ind. Bat. 3 (1857) 528. — *X. sumatrana* MALME, Bull. Jard. Bot. Botz III, 10 (1929) 391. — *X. novoguineensis* HATUS. Tokyo Bot. Mag. 56 (1942) 422. — *X. flabellata* v. ROYEN, Blumea 7 (1953) 308; Fl. Males. I, 4 (1953) 375.

Distr. S. America, S. Africa, India, Thailand, Indochina, China, throughout *Malesia*.

Ecol. In open, swampy places among sedges on *Sphagnum*, 600–3300 m.

6. *Xyris wallichii* KUNTH, En. Pl. 4 (1843) 16. — *X. oreophila* RIDL. J. Fed. Mal. St. Mus. 7 (1916) 121; v. ROYEN, Fl. Males. I, 4 (1953) 372. — *X. malmei* v. ROYEN, Blumea 7 (1953) 307; Fl. Males. I, 4 (1953) 370.

Distr. India (Silhet, Khasya), Burma (Moulmein), Vietnam (Chapa), Thailand; in *Malesia*: Malay Peninsula.

Ecol. In wet, mossy places on rocks, 850–1300 m.

7. *Xyris oligantha* STEUD. Syn. Pl. Glum. 2 (1855) 288. v. ROYEN, Fl. Males. I, 4 (1954) 599. — *X. pauciflora* auct., *non* WILLD.: R. Br. Prod. 1 (1810) 256, *quoad descr.*

Distr. Australia (Cape York Peninsula); in *Malesia*: Aru Is. and New Guinea (Papua, Western Distr.).

Ecol. In wet, sandy places among sedges and grasses, up to 60 m.

8. *Xyris pauciflora* WILLD. Phytogr. 1 (1794) 2; v. ROYEN, Fl. Males. I, 4 (1953) 371. — *X. pauciflora* var. *oryzetorum* MIQ. Fl. Ind. Bat. 3 (1857) 529. — *X. dajacensis* v. ROYEN, Blumea 7 (1953) 308; Fl. Males. I, 4 (1953) 372. — *X. maritima* KOYAMA, Philip. J. Sc. 84 (1956) 367.

Distr. Ceylon, India, Burma, Thailand, Indochina, China, Hong Kong, Taiwan, throughout *Malesia* to Australia.

Ecol. In open, wet places on sandy soil, from sea level up to 900 m.

The following species have to be Excluded:

4: 369b *Xyris tuberosa* RIDLEY, J. Fed. Mal. St. Mus. 10 (1920) 122.

Distr. So far recorded from Laos, Cambodia and Thailand (type, 'Mainland shores of Takuapa') only.

4: 371b *Xyris lobbii* RENDLE, J. Bot. 37 (1899) 506, t. 403, f. 17–24.

Distr. So far recorded from Burma (type), Thailand and Vietnam only.





# INDEX TO SCIENTIFIC PLANT NAMES

compiled by

M.J. VAN STEENIS-KRUSEMAN and E.E. VAN NIEUWKOOP

*Families* and higher taxa have been entered under their name.

Names of families which have been revised in volumes 4–9 have been entered and are printed in **bold type**, so that as far as this is concerned this index is complete for all preceding volumes as well.

*Suprageneric epithets* have been entered under the family name to which they belong preceded by the indication of their rank (subfamilies, tribes, etc.).

*Infrageneric epithets* have been entered immediately under the generic name to which they belong preceded by the indication of their rank (subgenera, sections, series, etc.).

*Infraspecific epithets* have been entered under the specific name to which they belong preceded by the indication of their rank (subspecies, variety, forma, etc.).

*Epithets of new names* and *new combinations* have been printed in **bold type**, *synonyms* in *italics*.

Page numbers in **bold type** denote main treatment; an *asterisk* behind a page number denotes the presence of a figure of the concerned taxon; 'map' printed behind a page number denotes that a map of the concerned taxon is present on that page.

Some minor printing errors in plant names have been corrected.

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